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ADENOMATOUS POLYPS OF THE COLON

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The best way to cure cancer is to prevent it. At present, no part of the human anatomy lends itself to this thesis more readily than the colon. It is recognized that carcinoma of the colon frequently arises from adenomatous polyps. When these tumors are found and removed, many carcinomas are prevented.

Pseudopolyps do arise in cases of long standing chronic inflammation, but they are not discussed in this paper.

There is some lack of uniformity in the pathologic interpretation of early malignancy in polyps of the colon and rectum. Swinton's and Warren's criteria for malignant changes in adenomatous polyps, anaplasia, irregularity of architecture and invasion, have been accepted. Too frequently a small piece of tissue is removed from the polyp with a biopsy forcep and sent to the pathologist for diagnosis. He may report the specimen as showing early malignant changes and a radical operation is advised; thus the patient loses his rectum when a simple excision of the polyp would have cured him. There should be the closest cooperation between the pathologist and the surgeon, and whenever possible, the entire polyp should be removed and sent to the pathologist. This can best be done under general anesthesia. The anus can be dilated and the tumor pulled down and removed with an elliptical incision followed by closure of the mucus membrane. In some cases the snare is most helpful. A brief personal interview with the pathologist is invaluable and gives him an opportunity to assist the surgeon. If the polyp shows all of the criteria of malignancy, including invasion, radical surgery should be recommended without delay. If the polyp shows other changes without invasion, local excision will be sufficient. A competent decision can be made only when the polyp is removed in toto and submitted to the pathologist.

Three patients have come under my observation who were advised by surgeons elsewhere to have an abdominal perineal resection of the rectum. In each case, a small piece of a polyp had been removed with the biopsy forceps and a pathologic report of early malignancy had been given. When the remaining portions of the polyps were removed with an elliptical incision, no evidence of invasion was present. All 3 patients have remained well for more than 5 years. Whereas re-

removal of the rectum in these patients would have seemed rather radical treatment, still it would have been preferable to allowing one or more of them to die as a result of carcinoma.

There are, of course, border line cases which require the best of surgical judgement in advising the patient. If treated by local excision, they require most careful follow-ups—evidence of recurrence at the same site in these doubtful cases is usually sufficient evidence for a radical operation.

The presence of an adenomatous polyp in the rectum, seen through the proctoscope, is adequate indication for a careful barium study of the colon by a competent radiologist. All that has been said about proper preparation of the colon for such studies cannot be over emphasized. The radiologist must be depended upon for diagnosis of lesions above the reach of the proctoscope, but at the same time he must not be depended upon for diagnosis of lesions which can be seen by the proctoscope or sigmoidoscope.

When a polyp has been proved by the roentgenogram to be present in the colon, above the reach of the proctoscope, what should be the approach? Before a surgical removal is recommended, the polyp should be shown on at least two examinations in which the air barium double contrast technic has been used.

Surgical removal of such lesions should then be through a laparotomy incision. Technic should be altered somewhat between children and adults. In children colotomy and polypectomy are indicated. In adults segmental resection of the involved portion of the bowel along with its mesentery is the better procedure unless the polyp has a long uninvolved pedicle. If multiple polyps occur in a segment, the entire polyp bearing segment should be removed. The continuity of the bowel can easily be re-established and the risk is no greater than if colotomy had been done. Location of the polyp at the time of laparotomy is sometimes difficult. If, after careful palpation, the tumor cannot be located, the bowel can be opened and a sterile proctoscope introduced. As in all cases of colon surgery, good and proper preoperative preparation is mandatory.

Polyps with long pedicles are more apt to be benign than sessile or villous polyps. Any patient who has one or more adenomatous polyps of the colon has a tendency to produce other polyps. The fact must not be overlooked that small polyps, undiagnosable in size, may exist at the time. For such reasons careful follow-ups on these patients is most important. They should be examined with the proctoscope at intervals of 3 and 6 months and studied by roentgenogram every year. If any symptoms persist, especially blood in the stools, the examinations should be repeated.

It must be remembered that patients who have carcinomas of the colon may have polyps in other segments of the colon. These should be looked for and removed if found. Frequently attention is focused on the carcinoma, and polyps in other areas of the colon are overlooked.

SUMMARY

We, of the medical profession, should be diligent in our search for adenomatous polyps of the colon by digital examination, by proctoscopic and sigmoidoscopic examination, and by air barium double contrast roentgenograms.

Rectal polyps should be removed in toto by the most feasible method and submitted to the pathologist for careful study. They should never be destroyed by fulguration without biopsy.

If one polyp is found, careful search for others should be made.

Rectal polyps which show malignancy with invasive power should be treated by radical surgery. Local excision will usually suffice for others.

Polyps above the reach of the proctoscope should be removed by laparotomy and resection.

Adenomatous polyps of the colon are precarcinomatous lesions. By removing these tumors, cancer can be prevented.

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HIATUS HERNIA: SURGICAL MANAGEMENT

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It is the intent of this paper to present an outline for the surgical management of hiatus hernia; sliding and paraesophageal.

Certainly there must be indications for surgical therapy in this disease as there are in all others. It is not that a hernia is present that we are concerned, but rather the pathologic sequelae of such herniation. If pathology does not follow or is not apt to, then the problem is resolved, for surgical therapies are not needed and indeed, if employed, may not only add undue risk but may produce harmful results in themselves.

First, then, we realize that small asymptomatic sliding hiatal hernias are most common, usually discovered during roentgenologic examination for other diseases, and are not to be considered proper surgical problems. Surely it is important also to stress that in the management of symptomatic hiatal herniation, medical and surgical investigation and therapy must go hand in hand, each used as the underlying pathologic process dictates application thereto.

Anatomic Points of Importance: At the normal esophagogastric juncture, multiple anatomic factors are at work and function to allow easy swallowing and effective retention of food and gastric juice in the stomach. Which of these anatomic structures reigns supremely important is impossible to say. Each has its advocates but nowhere is there a denial of the importance of all. As the esophagus passes through the diaphragm the right crus forms a muscular sling or "*pinch cock*"¹¹ that tethers the gullet back and to the left; contracts during inspiration, compressing the esophageal lumen. At the lower gullet a functional "*intrinsic sphincter*"¹⁰ has been demonstrated to contract and protect the esophageal mucosa. As the gullet enters the stomach, it does so in an oblique manner, due largely to the acute rise of the adjacent gastric fundus, and thus there is formed "*mucosal valve*"¹³, another preventor of regurgitation. Attached to the esophageal wall above and coursing below to insert into the tough fibrous structures beneath the diaphragm is the "*phrenicoesophageal ligament*"¹⁶ acting to maintain a normal esophagodiaphragmatic alignment.

In the *sliding hiatal hernia*, the anatomy about the cardia is deranged. Marked increases in intra-abdominal pressures (obesity, pregnancy, tumor, exertion combined with a fatty or atrophic diaphragm, etc.) tend to "*push*" the stomach upwards. Simultaneously, the negative intrathoracic pressures work to "*suck*" this same organ into the chest. As a result, the "*sling*" of the right crus of the diaphragm encircling the esophagus incurs a separation of its crossed and longitudinal fibres lying behind the esophagus and the hiatus enlarges, oftentimes to an alarming degree. This hiatal distention forces a relaxation of the phrenico-

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esophageal ligament and the cardiac stomach then rises to assume an intrathoracic position. The esophagus naturally shortens because of the contraction of its longitudinal muscles. This assumption of intrathoracic locale by the stomach destroys the angle between fundus and gullet and the mucosal flap disappears. Only the intrinsic sphincter is left and its ability to function properly in the face of surrounding anatomic alterations is decreased or absent.

With *paraesophageal* herniation, the esophagogastric junction maintains its normal position. This is the significant differential point. The factors acting to prevent gastric reflux are therefore functioning. A persistent pneumatoenteric recess on the right of the gullet may provide a hernial sac for the fundic part of the stomach or an acquired sac may result in front or to the left of the esophagus. Once herniated, the gastric pouch itself may suffer pathologic changes associated with its abnormal position.

Surgical Management: Certain basic principles of good medical care need be recognized and adhered to. First, a proper and complete evaluation of the patient must be obtained. This includes a complete history and physical, blood chemistry studies, roentgenologic examination and esophagoscopy. It is, for example, as important to determine the presence or absence of associated diseases (cholecystitis, peptic ulcer, coronary disease) as it is to prove regurgitant esophagitis. The importance of rendering treatment to the *whole patient* and not to the *hernia alone* must be stressed.

In accordance with the thoughts expressed and because successful management demands that medical and surgical care go hand in hand, a classification for clinical management has been devised. Although pain, bleeding and obstruction are the commonly considered surgical indications,^{11, 19} a practical consideration should indicate the source and degree of pathology, and relationship to other symptomatology present. As an example, pain, bleeding and dysphagia may all accompany esophageal ulceration. As a rule, the bleeding is minimal and the pain and dysphagia are maximal. A workable classification for clinical management would recognize that this certain single pathology may be responsible for multiple symptoms and would direct the patient to medical measures, perhaps accompanied by esophageal dilatation; hernial repair reserved for failures.

Classification for Clinical Management of Hiatus Hernia

- I. Asymptomatic
 - a. Small hernia
 - b. Large hernia
- II. Obstruction
 - a. Esophagitis
 - b. Ulceration
 - c. Stenosis
- III. Bleeding
 - a. Incarceration
 - b. Ulceration
 - c. Gangrene

IV. Pain

a. Retrosternal

b. Epigastric

c. Referred

I. Asymptomatic: a. Small hernia. A small asymptomatic sliding hiatal hernia is extremely common. As one author puts it, "It is not clear to me why all people do not develop a sliding hiatal hernia."¹⁹ Special radiologic technics have been evolved that will result in demonstration of minimal herniation in increasing numbers of patients.²⁰ When such asymptomatic hernias are discovered, no investigative or therapeutic procedures are required except for measures directed toward reduction of factors causing undue intra-abdominal tension; i.e. obesity corsets, etc.

b. Large hernia. Even though asymptomatic, patients with large hernias, especially if paraesophageal and particularly if fixed, should be prepared for operative treatment of the defect. If, for example, the patient is obese, dietary reduction should ensue and weight should be lost preoperatively to render the patient a safe surgical risk. Large hernias tend to undergo torsion, incarceration and ulceration. If, therefore, the patient's general condition is good or can be improved to the point where he will tolerate surgery safely, these large defects are better repaired rather than waiting for a frequent development of serious sequelae. A word of caution: If the operative repair cannot be done safely, the patient whose hernia is causing no distress should be left alone. The danger of future serious pathology is not so great in an asymptomatic hernia as is the danger of subjecting an obese or poor-risk patient to operation.

II. Obstruction: a. Esophagitis. With disruption of the cardiac anatomy in sliding hiatal hernia, the mechanisms to prevent acid-peptic regurgitation are lost. As noted before, such reflux does not occur in paraesophageal herniation. With sliding herniation, the gastric juice flows into the esophagus, especially when the patient is dependent or bends forward and the sensitive esophageal membrane is irritated. These patients suffer dysphagia. Although the roentgenologic examination frequently reveals regurgitation of barium, the esophagus may appear normal to the observer. However, early hyperemia and edema of the lower gullet are noted by the esophagoscopist and the esophagealgastric juncture is seen to remain patent in a "fish mouth" form. Gastric acid flows easily into the gullet with each inspiratory effort. As the reflux progresses, so does the severity of esophagitis until an angry, beefy red mucosa meets the examining eye. As a rule, the roentgenologic study during this phase of pathology indicates a distorted, partially obstructed lumen. The treatment indicated is medical with adequate antulcer medicines and diet, a head-up (10 inches) sleeping posture and measures to reduce etiologic factors. There are, in addition, instances requiring esophageal dilatation with graduated sounds, should dysphagia be severe or slow in responding to medical measure. Only after failure of adequate conservative medical therapy and proper readying of the patient is surgical repair indicated. Repeat esophagoscopy examination to determine the effectiveness of the medical therapy is most helpful.

b. *Ulceration.* Usually the ulceration is small and located at the juncture of the lower esophagus and stomach. Associated esophagitis and gastritis is the rule. Roentgenologic studies may reveal the presence of ulceration. Some degree of minor stenosis is a frequent accompanying complication. Here again, medical treatment should first be rendered and operation reserved for the failures.

c. *Stenosis.* Coexisting with the process of chemical irritation and inflammatory response is the natural attempt at repair. With long standing esophagitis and linear ulceration, there occurs a deposit of fibrous tissue encircling the point of greatest trauma, i.e. the esophagogastric juncture. This scar tissue contracts and a narrowing of the esophageal lumen results. It is nature's way of preventing further reflux and this aim is accomplished. However, swallowing becomes difficult, weight is lost and the gullet above dilates but retains its propulsive character. At esophagoscopy, the degree of stenosis is accurately gauged. It may range from pin point to minimal narrowing. At this point, one should stress the importance in obtaining a biopsy in each case of hiatal hernia submitted to esophagoscopy. In patients with stricture, this admonition becomes doubly significant for it is of extreme importance that carcinoma of the esophagus and thoracic stomach be excluded.^{17, 18} In the case of patients with stenosis, medical management with graduated esophageal dilatation as needed is most important. Good results in significant percentages have been obtained with this form of therapy.¹⁶ On the other hand, resection of the stricture frequently leads to further esophageal stenosis. To obtain lasting relief partial gastric and esophageal resection with reanastomosis, subtotal gastrectomy, esophagogastrectomy and substitution of small bowel or colon remain. These procedures must be employed only after clear demonstration of complete failure of conservative management.

III. *Bleeding:* a. *Incarceration.* A chronic anemia has been frequently noted in patients with hiatal hernia.^{14, 15} In both sliding and paraesophageal herniation gastritis and minute ulceration may be incurred as the result of undue and prolonged exposure to gastric juices when there is associated partial obstruction from contraction of the pillars of the diaphragm. Twisting of the entrapped gastric mass with consequent venous engorgement also causes a slow "ooze" or "weeping" resulting in secondary anemia. These patients frequently suffer epigastric fullness, pain and even dysphagia. If the area of gastritis is accessible to antulcer therapy, benefit may be derived by simple medical measures. However, if this situation is accompanied by demonstrated distortion of the herniated gastric lumen, surgical repair is indicated after proper preparation.

b. *Ulcerative.* As pointed out previously, the small esophageal ulcer is easily noted by esophagoscopy examination. This ulcer may bleed, but usually not to a serious extent. It may produce a mild anemia, but rarely a massive hemorrhage. A gastric ulcer lying within either a sliding or a paraesophageal hernia is, however, a common site of severe hemorrhage. It has been demonstrated statistically that gastric ulcers occurring in hiatal hernias are no more common than in the general population.^{4, 13} The prognostic factors associated with bleeding peptic ulcer should be observed here as in cases without hiatal herniation.²

Patients with massive upper gastrointestinal hemorrhage are treated for blood

loss and roentgenologic studies of the upper digestive tract are carried out as soon as possible. No increase in bleeding or mortality or morbidity results from either adequate blood replacement or from early roentgenologic examination. On occasion, the roentgenologic demonstration that bleeding is arising from ulceration within a hiatal hernia is of extreme importance.

CASE REPORT

R. K., a 55 year old housewife, was admitted to the hospital with a 2 week history of epigastric pain, tarry stools and weakness. Adequate medical treatment was begun, but melena persisted and the hemoglobin values decreased from 75 per cent on admission to 63 per cent 3 days later despite two transfusions. Shock ensued and after correction by blood replacement, a roentgenologic study of the esophagus and stomach was done and an active ulcer lying within a large diaphragmatic sliding hiatal hernia was demonstrated. The patient had had 8 abdominal operations during the prior year for treatment of a perforated sigmoid diverticula and peritonitis with subsequent abscess formation. A transthoracic approach gave easy access to the hernia and the ulcer lying along the lesser curve of the herniated cardia. A good recovery and result ensued.

This case illustrates the success of early adequate blood replacement for blood loss and the value of early roentgenologic studies to aid in diagnosis. In this instance, had no studies been made and had the operation been undertaken for bleeding duodenal or gastric ulceration via the abdominal approach, the presence of massive intra-abdominal adhesions and bands would have made exposure forbidding. The reduction and successful hernia repair and ulcer excision would have been near impossible had not the transthoracic route been employed.

c. Gangrene. Twisting of the herniated stomach with associated obstruction due to pillar contraction of the outlet in paraesophageal hernia and in large sliding hernia results in vascular impairment and gangrenous changes. This is a rare development but one that must be kept in mind when confronted with a patient suffering excruciating epigastric or retrosternal pain, shock and gastric upset. Immediate reduction and excision of the gangrenous wall is lifesaving.

IV. Pain: Allison stated: "A woman of 59 years of age complains that for 6 years she has suffered from intense burning pain behind the lower part of the sternum, which rises up toward, or even into, the neck. The pain may spread into the jaw, the ear or the hard palate, or radiate through to the back between the shoulder blades, or down the arm. It comes on especially when she exerts herself stooping forward, as in washing the floor, bending over the wash tub, poking the fire, or fastening her shoes. It wakes her in the middle of the night, especially if she is sleeping on her back or her right side, and she seeks relief from what she describes as an agonizing pain by sitting upright and taking a few sips of water, milk, or alkaline mixture. She says that her throat usually feels dry and burning. When she swallows she may be conscious of the passage of food down the gullet, it may cause a feeling of soreness and may sometimes lodge toward the lower end of the sternum, causing pain which is immediately relieved as the bolus passes into the stomach. If she bends forward after a meal, food or sour fluid rises into her throat and has to be swallowed again. Her husband said that for belching she takes the first prize. Four years ago she was thought to have cholecystitis, but removal of either a normal or abnormal gallbladder did not

cure her. Roentgenography of her stomach and duodenum shows no evidence of ulcer. She has tried all the advised stomach medicines with only temporary relief and finally has been told that "the nerves of her stomach have been upset by the change of life."

a. Retrosternal. The severity of the pain associated with regurgitant esophagitis usually is found to parallel the severity of esophagitis. Direct esophagoscopy visualization of the mucous membrane of the esophagus is the most reliable means of evaluating the symptomatology.

Occasionally one will find a minimal hiatal herniation associated with severe pain and only a moderately degree of esophagitis. In such instances, the gastric analysis may reveal high acid and gastric volume values. If medical therapy fails, repair may be done, keeping in mind the possible associated peptic ulcer diathesis.

b. Epigastric. This pain may be associated with multiple intra-abdominal and intrathoracic disease states. Indeed, although hiatal hernia has been termed the "masquerader of the abdomen"¹¹ it might with justice, be called the "masquerader of the thorax." Epigastric fullness, soreness, aching, burning and tenderness may be due to either the distended and irritated contents of a sliding or hiatal hernia, or it may just as easily be caused by coronary artery disease, cholecystitic pathology, peptic ulcer, hyperacidity, cancer of the stomach or appendicitis.⁵ The important thing to remember is that associated diseases are frequent^{7, 9, 16} and must be considered both as possible sources of the patient's symptoms and as possible etiologic agents of the herniation itself, i.e. vomiting and wrenching due to pylorospasm.

c. Referred. Here again the importance of detecting associated disease is important. For example, both esophagitis and angina pectoris may produce pain in the retrosternal area, neck and arms. Diaphragmatic irritation with referred pain to the shoulder may result from either hiatus hernia or acute or chronic lung pathology. A distended hiatal sac may cause epigastric pain referred to the back simulating gallbladder or pancreatic disease or it may assume such size as to mechanically cause dyspnea or even cardiac irregularities.⁶

SUMMARY

Hiatus hernia is of two types, sliding and paraesophageal. In the more common sliding variety, certain anatomy about the esophagogastric juncture is deranged due to a combination of congenital or acquired deficiencies and increases in intra-abdominal pressures. The stomach is forced into the chest, the esophagus shortens, and reflux of gastric contents is allowed. In the paraesophageal type, the esophagogastric position remains subdiaphragmatic, but the gastric mass herniates into a congenital or acquired recess. Because of these anatomic differences, the pathology resulting also is often quite different.

A classification for clinical management is presented and aims at stressing the need for constant hand in hand medical and surgical management, always treating the patient as a whole and applying proper treatment, be it medical or surgical as the underlying pathology dictates.

Most asymptomatic patients require only medical management and measures aimed at reducing etiologic factors, i.e. obesity. Large asymptomatic hernias, especially if fixed or paraesophageal are proper candidates for repair if and when the patient may be made a safe operative risk.

Obstruction, bleeding and pain are the common symptoms and if unrelieved by conservative measures and if severity warrants, constitute indications for surgical therapy.

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RESULTS OF TRANSURETHRAL PROSTATIC RESECTIONS IN PRIVATE PRACTICE

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Since the advent of the modern transurethral prostatic resection 20 odd years ago, there have been hundreds of papers dealing with various technics, pre- and postoperative management, morbidity and mortality. However, there have been very few reports of the late results following this operation. This fact prompted me to review these cases. These operations were carried out on private patients in five Charlotte hospitals from 1939 to the latter part of 1955. During this time 693 transurethral prostatic resections were carried out on 660 patients.

MANAGEMENT

Preoperative catheter drainage was used when indicated by the amount of residual urine, the kidney function and uncontrolled infection. Cystograms were done routinely on all patients and intravenous urography was carried out only if there were reasons to suspect upper urinary tract disease. The vasa deferentia were ligated rarely. Low spinal anesthesia was used in all patients unless contraindicated. The resecting instrument was the regular 28 F. Stern-McCarthy resectoscope except in rare instances when the smallness of the urethra necessitated the use of the 24 F. resectoscope. The several electrosurgical units all employed the tube rectified current for cutting and the spark gap current for coagulation. Sterile water was the irrigating fluid during these operations.

Postoperative bladder drainage was maintained for 4 or 5 days by means of a soft rubber catheter with a blunt tip and 2 eyes (Nos. 18F. to 22F.) being held in place with adhesive straps. This type of catheter is preferred to the self-retaining catheter because of its relatively larger lumen. The smaller catheter also allows better urethral drainage and lessens the amount of urethral irritation and infection which may lead to stricture formation. Antibiotics and chemotherapeutic agents were used only when indicated by fever. The patients were discharged from the hospital in 10 to 14 days after operation. The follow-ups were done in the office at monthly intervals for 3 or 4 months.

SELECTION OF PATIENTS FOR TRANSURETHRAL PROSTATIC RESECTIONS

The ages ranged from 41 to 91, the average age being 67.6 years. Of 720 patients operated upon for prostatic obstruction transurethral prostatic resections were carried out on 660 (91.6 per cent) (fig. 1). Twenty-nine patients had two prostatic resections and 2 patients had 3, making a total of 693 transurethral prostatic resections carried out on 660 patients.

The size of the gland as estimated by palpation, cystogram and cystoscopy, if

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Total no patients operated upon	720
No. patients having transurethral resection	660 (91.6%)
No. transurethral resection	693
No. enucleations	60 (8.3%)
No. carcinoma (path. report)	109 (15.14%)

FIG. 1. Prostatic operations 1939-1955

necessary, determines whether or not a transurethral prostatic resection should be carried out. In general, if the gland is estimated to weigh more than 50 grams, some type of open enucleation is preferred. However, there are many patients in this series in whom, because of the extreme age and poor general condition, transurethral prostatic resections were done on much larger glands. Patients of this type can frequently be helped by this less shocking procedure although a perfect result cannot be expected.

Carcinoma of the prostate was found by pathologic examination in 109 patients (15.14 per cent). This figure is in keeping with other reports.¹ However, it is surprisingly low when one considers that Hudson² in the "Bowery Series" found 39 cases of carcinoma of the prostate by arbitrary perineal biopsy on 300 unselected patients (13 per cent)! None of these patients had sought medical advice because of prostatic symptoms, and only 9 had rectal findings suggestive of carcinoma.

WEIGHTS OF REMOVED PROSTATIC TISSUE

The weights of the prostatic tissue removed transurethrally ranged from 1 to 56 grams, the average being 16.8 grams (fig. 2). This figure includes all cases—carcinoma, benign hypertrophy, median bar and sclerosis of the vesical neck. The weights of the glands removed by enucleation ranged from 40 to 350 grams, the average being 95 grams.

Transurethral prostatic resections (1 to 56 Gm.)	Average 16.8 Gm.
Prostatic enucleations (40 to 350 Gm.)	Average 95 Gm.

FIG. 2. Weights of removed prostatic tissue

Number operations	693
Deaths	
Septicemia-pyelonephritis	4
Pulmonary embolus	3
Cerebral hemorrhage	3
Coronary occlusion	3
Tubular nephrosis	1
	14
	2.02%

FIG. 3. Operative deaths, transurethral resections

MORTALITY

There were 14 deaths in this series of 693 prostatic resections (2.02 per cent) (fig. 3). The causes of death were as follows: septicemia and pyelonephritis 4, cerebral hemorrhage 3, pulmonary embolus 3, coronary occlusion 3, and tubular nephrosis 1. Three of these patients had additional operative procedures carried out in 5 to 7 days after the prostatic resection and died after the second procedure. These additional procedures were cystolithotomy, ureterolithotomy and subtotal cystectomy for carcinoma of the bladder.

RESULTS

After a transurethral prostatic resection, at least 3 months must elapse before the resulting infection can be eradicated (fig. 4). This usually is true regardless of whether antibiotics and chemotherapy are used during the interim. Therefore, 118 patients who were not followed for at least 3 months are not classified in these results. Many of them considered themselves well when they came back at 1 and 2 months and saw no need to return.

There were 312 patients who are classified as having a "Good" result. To be so classed the following criteria have to be met:

- (1) The patient must consider himself well
- (2) Void without pain or difficulty
- (3) Good urinary control
- (4) Nocturia not more than two times
- (5) No residual urine
- (6) Uninfected urine

No. of operations.....	693
Deaths.....	14
Insufficient follow-up.....	118
Good results.....	312
Fair results.....	248

FIG. 4. Results, transurethral resections

No. patients with fair results.....	248
No. patients with other diseases influencing the result:	
Carcinoma prostate.....	36
Carcinoma bladder.....	6
Stones & infection in kidneys.....	6
Diverticulum of bladder.....	11
Neurologic bladder.....	3
	62
	186

FIG. 5. Analysis of "fair" results, transurethral resections

- (7) No urethral stricture
- (8) No periodic hematuria.

It is at once apparent that these criteria are very strict and to be able to meet them the patient must have a perfect result.

There were 248 patients who are classified as having a "Fair" result (fig. 5). In 62 instances there were associated conditions which influenced the result and cannot be said to be the fault of the operation. These conditions are as follows: advanced carcinoma of the prostate 36, carcinoma of the bladder 6, renal stones and infection 6, vesical diverticula 11, and neurologic bladder 3. Almost all of the remaining 186 patients had persistent infection which could not be cleared. In most patients the infection caused no symptoms and these patients considered themselves well. Other patients, who had only mild symptoms, elected not to have more prostatic tissue removed.

Urethral strictures, which required periodic urethral dilatations, were present in 27 patients (3.9 per cent). This occurrence can be reduced by avoiding trauma to the urethra insofar as possible. This can be approached by using the smaller instruments which now are available and by doing a perineal urethrotomy which was not done in any of these patients.

Fourteen patients had episodes of gross hematuria which, at times, was sufficiently severe to require an indwelling catheter. This occurrence usually is the result of an inadequate prostatic resection and can be corrected by completing the job with another resection. For over 10 years I have administered stilbestrol to these patients and am convinced that it lessens the frequency and the severity of the hematuria. Estrogens are sometimes given pre- and postoperatively when excessive bleeding is anticipated or encountered. It was not at all surprising to see an article by Menger³ in 1955 in which he stated he administered estrogens parenterally in 16 cases of epistaxis and hemorrhage after adenoidectomy. He stated the response was dramatic in all patients and all bleeding stopped within 1 hour. He thought that its use was empirical, but suggested several possible modes of action.

There was only one case of true incontinence in this series and it must be considered as a very poor result. Thirty-one patients with poor results were reoperated upon. Twenty-nine of these patients had 2 resections and 2 patients had 3 resections before they could be promoted to a higher category.

SUMMARY

This report deals primarily with the late results of 693 consecutive transurethral prostatic resections carried out on 660 patients. Transurethral prostatic resection is done on 91.6 per cent of patients presenting themselves with prostatic obstruction. There were 14 deaths in the series, or 2.02 per cent. Three of the deaths included were on patients who had additional operative procedures carried out and died after the second procedure. In evaluating the final result, no patient is included who was not followed for at least 3 months. Of the 561 patients followed 3 months or more, 312 are classified as having "Good" results. The criteria are very rigid. Two hundred and forty-eight are classified as having

"Fair" results. Of these 62 had related conditions, that is: stones, vesical diverticula, pyelonephritis, and bladder paralysis. The majority of the remaining 186 considered themselves to be well although they could not meet the rigid requirements to be classified in the "Good" group. Most of them had persistent infection that could not be cleared. Urethral stricture occurred in 27 patients (3.9 per cent), and 14 patients had episodes of gross hematuria. One patient had incontinence of urine. Thirty-one patients with "Poor" results were re-operated upon.

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Charlotte, N. C.

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CONGENITAL ARTERIOVENOUS COMMUNICATION

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Congenital arteriovenous fistula is a condition that frequently is not recognized in its earlier phases. This is unfortunate because then it is most amenable to surgical correction (Cases 1, 2, 3, 4, 5). Characteristically it is progressive and often rapidly so if not interrupted. The fact that a dormant or small fistula may be activated by trauma often has contributed to inadequate treatment of the lesion (Case 8). Experience with this problem shows that continued observation and even repeated surgical attacks may be necessary for a good result since the lesion does not lend itself to easy demarcation and irradiation. Additionally new shunts may develop as the old ones are obliterated. An attitude of defeat should be avoided, however, for the stakes are high, often involving a whole extremity or even the patient's life. Persistence in diagnostic and therapeutic efforts often will be richly rewarded.

ETIOLOGY

The situation would be much clarified if the term arteriovenous communications or anastomoses were to replace that of fistula with the latter being limited to the solitary communication that results from trauma such as a gun shot or stab wound occurring between a major artery and vein. To speak of congenital arteriovenous communications more clearly suggests the etiology as well.

Arteriovenous anastomoses normally are found in the skin of the palm of the hand, terminal phalanx of fingers and toes, in the nail bed, skin of the lips, nose, eyelids and at the tip of the tongue. The lumen of these direct communications varies within wide limits but is contracted a large part of the time. When open, these communications shunt a considerable amount of blood and probably are a mechanism for regulating local blood flow and blood pressure. Abnormal arteriovenous communications have been found in vascular neoplasms, pathologic conditions resulting from injury and in developmental anomalies.

During embryonic development the arteries and veins differentiate from a common capillary plexus. It is believed that failure of differentiation, failure of closure or reopening of points of closure are the causes of the lesion. The latter situation seems to apply in those cases where the lesion develops after trauma or infection in an extremity (Case 7). Normally a few shunt systems persist in extremities as the neuromyoarterial glomus. In trauma and infection it is possible that this system may be damaged and rendered insufficient and thus start the self propagating pressure differentials which create further arteriovenous shunts.

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CLINICAL MANIFESTATIONS

The prime factor in correct diagnosis is of course the consideration of the entity. Therefore, as the discussion on etiology has suggested, the possibility of congenital arteriovenous communication must be considered in any compressible soft tissue enlargement of any size and extent in any location and at any age from birth to later life. There may or may not have been a precipitating incident of damage in the area.

Certain specific pictures when present are almost certainly indicative. For example, varicose veins in an upper extremity with or without a wound which does not heal. Gigantism of a single extremity with varicose veins at an early age often is the presenting picture. Enlargement of a single or multiple digits. Elongation of an extremity in the growing child may be the first evidence. Hypertrophy of a single muscle group has been observed (Case 6). Unexpected gangrene or failure of wound healing in an extremity, with or without a surprising problem of hemorrhage after a usually insignificant injury, may be the initial indication. Any type of hemangiomatous lesion of the skin anywhere should immediately raise the question of a possible accompanying congenital arteriovenous communication. Pulsation of the mass is uncommon so emphasis is placed on finding a tumor which is compressible but refills rapidly with release of the pressure.

When any of the above situations are found, examination should include a search for the confirming findings as listed below:

1. The skin temperature of the area or extremity is elevated because of the increased vascularity.
2. Bruits or thrills in most cases will be absent, because the communications are multiple and small. If present, however, they are very significant (Case 9).
3. The pulse rate may be decreased 4 to 8 beats per minute upon compression of the main artery above the arteriovenous communication because of reduction of the amount of blood escaping through the shunt.
4. Cardiac enlargement may occur if the volume of shunt is great, but is not found in the smaller lesions.
5. The blood pressure in the affected extremity is sometimes elevated over the pressure in the comparable normal extremity.
6. Increased oscillometric readings are the rule in extremity lesions.
7. Increased growth of hair or increased sweating in the affected part often is observed.
8. Areas of adjacent telangiectasia often occur.

SPECIAL DIAGNOSTIC PROCEDURES

Certain procedures may be carried out to aid in diagnosis and determination of the location and extent of the lesion.

1. A roentgenogram may disclose bone changes resulting from an invading or adjacent lesion.
2. Oxygen saturation determinations should be made on the venous blood

from the area since there will be a distinct increase in the presence of an arteriovenous communication (Case 4).

3. Arteriography often will demonstrate the rapid passage of the media into the venous circulation or even the location of a small localized communication (fig. 1). A full appreciation of the extensive collateral circulation also will be gained. Frequently the arteriogram will be of academic interest only, but even then may help to show the adequacy of excision after treatment.

4. Venograms made by injecting the contrast media into the vessels in the suspected area may help to confirm or localize the lesion (fig. 2).

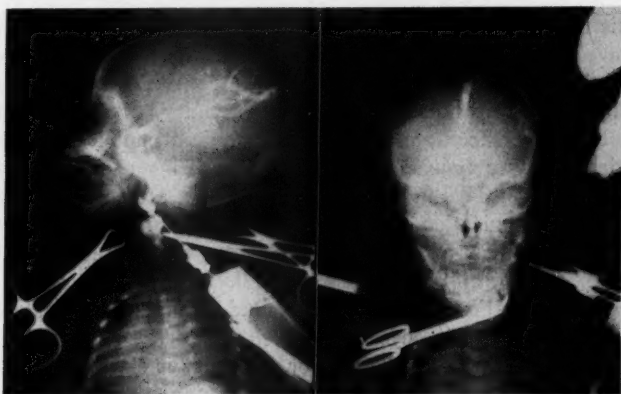


FIG. 1. Case 1 showing radiopaque material entering venous sinuses directly from injected left internal carotid artery.



FIG. 2. Venogram showing localization of dye in greatly dilated veins (Case 7)



FIG. 3. Infrared photograph showing extensive involvement, left shoulder, girdle and arm (Case 4).

5. If plethysmography is available the greatly increased rate of blood flow to the extremity can be measured.
6. Pulse volume measurement will show an increase over the normal extremity.
7. Infrared photographs may aid in localizing the lesion (fig. 3).

TREATMENT

As previously emphasized, the earlier treatment is begun the better the chance of cure or at least arrest of the process with its many dangerous sequelae (figs. 4, 5). The preferred treatment is surgical excision with ligation and division of all vessels large and small entering the area of the lesion, except of course, the major arteries. Simple ligation of the major artery of the area proximally is not satisfactory (Case 1) and may be dangerous in that gangrene of the distal portion of the extremity may result.

If a direct surgical attack cannot be made because of inability to locate the communications, then ligation of all veins in the area may be beneficial in arresting the process (Case 4). While the exact reason for this cannot be stated it appears to be a possible result from alteration of pressures and hemodynamics with possible subsequent thrombosis or even spontaneous closure of the sites of communication.

During the surgical procedure the amount of blood lost is always considerably more than anticipated in spite of all technical maneuvers to minimize it, (Case 2). Adequate blood must be available and good judgment used in terminating the procedure. Dissection in a bloodless field using a tourniquet is not advisable as postoperative hemorrhage may occur because of the failure to ligate all open vessels.



FIG. 4. Five week old infant showing large compressible tumor of back before operation (Case 2).



FIG. 5. Tumor of back excised showing extirpation of area containing multiple abnormal communications (Case 2).

In utilizing two stages the first may be necessary to ligate the superficial dilated veins in order that the deep and usually the more important communications may be ligated during the second or third stage. Elevation of the local venous pressure, resulting from the ligation of all veins within the surgical field, encourages thrombosis—often seen at the second stage—changes the hemo-

dynamics and presumably brings about the closure of many or all of the small communications.

Ideally the entire excision of the involved structures is most desirable (Case 2, 3, 6, 7, 9) and the results are more likely to be successful (fig. 6). An excellent



FIG. 6. Localized lesion in a young woman with complete extirpation and complete remission of throbbing pain in the area present for several years (Case 8).



FIG. 7. Showing original facial tumor (Case 6)

result in such instances may be secured unless new communications subsequently appear (figs. 7, 8, 9). Communications are more localized in infancy, therefore this group responds best to surgical treatment.

The problem in identifying the approximate location of these shunts is a difficult one. Thrill or bruit is not present to guide the surgeon. Obliteration of the



FIG. 8. After extirpation of tumor with preservation of facial nerve (Case 6)



FIG. 9. Showing return of process with hypertrophy of masseter muscle and spread into pterygoid fossa resulting in pressure changes of facial and skull bones.

apparent arterial supply may, at the time of operation, not appreciably alter the volume of blood discharged from an open vessel since the collateral circulation is extensive.

It must be emphasized again that complete eradication of the lesion often is not possible in a single stage. Repeated surgical attacks may be necessary because of an extensive lesion or the appearance of new communications as the old ones are obliterated. Frequent examination of the patient is advisable so that the latter situation may be dealt with at the earliest possible time.

CASE REPORTS

Case 1. M. G. D., a 6 day old baby girl, was admitted to the hospital on Jan. 16, 1953.

History: This infant was born on Jan. 11, 1953. Her birth weight was 6 pounds 13 $\frac{3}{4}$ ounces. No cyanosis or other difficulty was noted at birth. On the second day of life, a cardiac murmur was heard. On January 15 it was noted that the liver was palpable and that the patient had a tachycardia.

Physical Examination: Physical examination was that of a well developed, well nourished active 6 day old infant. The skin had a mottled appearance. Ear, nose and throat examinations were normal. Left chest seemed more prominent than the right, the lungs were clear to auscultation and percussion. The heart rate was 180 per minute and the rhythm regular. There was a harsh systolic murmur in the fourth and fifth interspace to the left of the sternal border. The liver, kidney and spleen were not palpable. Genitalia and anus were normal. Spine and extremities appeared normal. Provisional diagnosis was that of congenital heart disease, probably patent ductus arteriosus or interventricular septal defect.

Progress and Treatment: The child was started on evaporated milk formula, oxygen was given PRN and Digelin was continued. The child's condition became rapidly worse with increased respiratory rate, cyanosis, splenomegaly and an apical rate of about 200. Digitoxin was given and Digelin was discontinued. Oxygen and other symptomatic treatments were continued. The condition of the child improved somewhat after this. Repeat heart fluoroscopy on January 26 showed progressive cardiac enlargement to an extreme degree with evidence of left sided failure.

On January 30 an additional consultant noticed that in addition to previous cardiac findings there was a continuous blowing murmur over the entire head. The diagnosis of arteriovenous fistula located intracranially was made. The patient was seen by a neurosurgical consultant and he suggested left carotid arteriogram and ligation of the common carotid artery. On February 3, a left cerebral arteriogram was done and this showed a large arteriovenous fistula involving a branch or extension of the right cerebral artery and the venous plexus at the anterior end of the straight sinus. The arterial vessel was of the same diameter as the internal carotid, so that most of the blood from that vessel was shunting directly into the dural sinus. Immediately after the arteriogram, the left common carotid artery was ligated, as was the left jugular vein. The patient withstood the operative procedure satisfactorily.

Following surgery, Penicillin and Streptomycin were given; Digitoxin was continued. Respirations became better and the heart rate slowed to between 120 and 130 per minute. A slight murmur could be heard in the preauricular region. The murmur in the head was somewhat diminished.

Course: From then on there was slow but progressive deterioration. The child was almost constantly in oxygen. Repeated episodes of congestion necessitated small doses of Mercurhydrin. The child was unable to take feedings from a bottle well and gavage feeding was necessary most of the time. Repeated electrocardiograms showed little change in tracings. Her condition gradually became worse and the patient died on March 28, 1953.

Diagnosis: 1. Intracranial arteriovenous fistula with cardiac hypertrophy, dilation and decompensation. 2. Patent ductus arteriosus.

TABLE 1
Congenital arteriovenous fistula
 Review of 9 cases

Case	Sex	Age	Location of Communications	Type of Treatment	Result
1. MGD	F	6 days	Right cerebral artery with venous plexus anterior end of straight sinus	Ligation, left common carotid artery and left internal jugular vein	Died 2 mo. later
2. CGF	F	5 weeks	Left upper back	Excision of tumor. Cardiac arrest due to blood loss	No recurrence—1 year Normal development, no evidence of brain damage
3. PG	F	8 weeks	Overlying right scapula	Excision of tumor completely	No recurrence 4 years
4. JPG	M	17 months	Neck, chest, shoulder, arm, forearm and fingers	Exploration of axillary and brachial arteries. Ligation of all veins encountered	Alive and well 6 years later. No evidence of cardiac hypertrophy. Dilated arm veins diminished in size
5. LJM	F	5 years	Left neck, right neck, tongue, right submaxillary gland, oral pharynx, hemangioma of vulva, right buttox & left mastoid area	1. Superficial eradication of dilated veins 2. 7 months later radical neck dissection	Improved but recovering from second surgical procedure, in hospital now
6. JEG	M	8 years	Face, temporal fossa, pterygoid fossa, masseter muscle	Excision facial tumor. Ligation of all veins encountered	Recurrence suddenly 3 yrs. later. Now has massive facial asymmetry
7. RBT	M	16 years	Left humerus, plus medial aspect arm and forearm	Excision including medial epicondyle of left humerus plus ligation of all veins in the area	On full duty in the Army—no recurrence
8. MK	F	23 years	Left frontal area above supra-orbital ridge	Arteriogram-ligation temporal artery, excision of tumor	No recurrence 6 months
9. Mac	F	41 years	Left lower lobe of lung	Lobectomy	Murmur disappeared. Diastolic and systolic blood pressure increased

Case 2. C. G. F., a 5 week old baby girl, was admitted to the hospital on Nov. 29, 1954.

History: This infant was admitted for a large mass overlying the left scapula, present since birth and increasing in size.

Examination: Physical examination confirmed the presence of a compressible bluish mass overlying the entire left scapula and extending into the left axilla. Laboratory data: The hemoglobin was 9.75 grams (elevated to normal limits by blood transfusion). The chest roentgenogram showed this soft-tissue mass.

Operation: On December 3, excision of this vascular tumor was attempted. It was obvious that the major component of the blood supply to this tumor was arterial in nature. Blood loss was considerable and after the major portion of the tumor was excised, ventricular fibrillation occurred. Thoracotomy was performed and cardiac massage instituted. This cardiac arrest was on the basis of blood loss so additional blood was given. A regular sinus rhythm developed and continued throughout the procedure. The thoracotomy and original incisions then were closed with the patient in fair condition. Maximum temperature rise postoperatively was 103 F. with return to normal in 3 days. Oozing of blood from the operative site was moderate postoperatively but the hemoglobin was maintained by transfusions. The child was lethargic but showed no evidence of tremor or rigidity. Her oral intake improved rapidly and she gained to her preoperative weight by the end of her hospital stay. Moderate lethargy was present at time of discharge.

Pathologic diagnosis: Arteriovenous fistula, congenital. Cardiac arrest.

Course: Satisfactory general condition. Wound area returning to normal. No evidence of brain damage now 16 months later. She walks and talks in a normal fashion. The patient was discharged on Dec. 22, 1954.

Case 3. P. G., an 8 week old baby girl, was admitted to the hospital on Nov. 4, 1952.

History: Shortly after birth, a white birth mark was noticed in the upper back region in the area of the right scapula. Subsequently this area became red during the second week of life and then a tumor began to appear.

Examination: Physical examination revealed a tumor which was movable, high in the back, and covered with a port wine type of stain. This tumor was compressible and rapidly refilled following compression. The diagnosis was that of arteriovenous fistula, right scapular area.

Operation: On November 12, the congenital arteriovenous fistula was removed in toto from the upper portion of the right back extending under the trapezius muscle. This tumor measured 2 by 1 inch in diameter. During the procedure, there was extensive loss of blood. The vascular lesion extended down to and including the fascia of the trapezius muscle itself.

Pathologic diagnosis: Capillary and cavernous hemangioma of the dermis and hypodermis. Review of this lesion, however, reveals it to be similar to other types of tissue removed from arteriovenous fistulas of the congenital type.

Course: No evidence of recurrence.

Case 4. J. P. G., a 17 month old baby boy, was admitted to the hospital on June 25, 1950.

History: Cyanosis of the left arm and pectoral girdle present since birth. No enlargement of the arm, blood pressure changes, thrill or bruit.

		Right arm	Left arm & wrist	
Venous blood	CO ₂ content	32.7 Vol.%	34.2 Vol.%	31.5
Venous blood	O ₂ content	7.7 Vol.	11.7 Vol.	12.6
Venous blood	O ₂ saturation	45.0%	68.4%	73.4%

At 12 months of age the axilla was surgically explored and many sacculations of the axillary vein were found, but no distinct arteriovenous communication demonstrated.

Examination: At 17 months of age examination revealed cyanosis of left arm and neck. Increased growth of hair on left arm and forearm noted. Roentgenogram of the chest disclosed left ventricular enlargement and EKG showed left axis deviation.

Operation: Through an incision on the medial aspect of the left upper arm, brachial

veins of $\frac{1}{4}$ inch diameter were encountered which contained bright red blood. The median cubital vein was 4 times larger than normal. All dilated vessels were ligated and divided including all the major veins of the arm in the area. The index finger was explored and all veins ligated.

Pathologic diagnosis: Congenital arteriovenous fistulas, left arm and forearm.

Course: Patient living and well with no increase of signs or symptoms. The arm becomes cyanotic when he cries. The patient was discharged on July 6, 1950.

Case 5. L. J. M., a 5 year old white girl was admitted to the hospital on Aug. 28, 1955.

History: This patient had recurrent attacks of bronchitis, shortness of breath and bulging of neck veins over the past 3 years. She did not get cyanotic. There was no history of hemoptysis. The last attack of bronchitis occurred 1 month ago and responded to antibiotics. The patient was born with multiple arteriovenous fistulas over the face, neck and upper chest. At 9 months of age she had ligation of some vessels in the neck and the same procedure 6 months afterward. There was no history of allergy.

Examination: Physical examination showed the patient to be a well-developed, well-nourished white female who was alert and cooperative and in no acute distress. Vital signs were stable. The significant abnormality was the presence of multiple subcutaneous arteriovenous fistulas over face, neck, chest, left labia and buttocks. A small hemangioma was present over the left temporal occiput. There was a hemangioma involving the floor of the right mouth, tongue, tonsil, right palate and pharynx. Her heart and lungs were clear. Her blood pressure was 120/70. Strong femoral pulses were present.

Provisional diagnosis: Multiple arteriovenous fistulas, face, scalp, neck, chest. Recurrent bronchitis, unknown etiology.

Laboratory data: Laboratory work was essentially normal.

Course and Treatment: On August 29 the patient was taken to surgery and under a general anesthetic was bronchoscope. During bronchoscopy, soft blue tumorous tissue was seen to extensively involve the right side of the tongue, palate, tonsillar and subtonsillar area and extend down into the piriform sinuses and inside the larynx down to the cords. It was necessary to advance the instrument with extreme caution because of this distended vascular tissue. The epiglottis was located and appeared to have been infiltrated by the same type of tissue. The bronchoscope was passed through the vocal cords without bleeding or difficulty. The trachea was normal and the carina was sharp and in the midline. Both main bronchi appeared normal. The scope was withdrawn and passed into the esophagus for about one-third of its length. No involvement of the esophagus below the cricopharyngeus was noted. The patient withstood the procedure well. Blood volume studies were done using I-131 serum albumin and was found to be 2128 cc. Roentgenogram of the esophagus was negative for varices or displacement. Her chest was clear and her skull showed an unusual number of venous channels in the parietal bones bilaterally. The patient was discharged after diagnostic studies. The patient was re-admitted 1 week later. Skull films showed lakes of blood. The oximetry and blood saturation studies showed an increase in oxygen saturation of the neck veins.

Second admission as follows:

Examination: Temperature was 100 degrees, weight 34 pounds. This was a well-developed, well-nourished white girl in no distress. However, she was 10 pounds underweight. There were prominent arteriovenous fistulas behind the left ear, over the right face and mouth, thus producing a distortion of the right side of the face. The left tympanum was honey-combed, but there was no obvious drainage. There was no pharyngitis. There were dense arteriovenous communication masses involving the tongue, right cheek, palate and floor of the mouth. There were large, soft arteriovenous masses in the right neck and over the right upper chest. Lungs were clear to percussion and auscultation. Her heart was negative. The remainder of the examination was negative.

Provisional diagnosis: Multiple arteriovenous communications of the hand, face, mouth, neck and chest.

Laboratory data: The admitting hemogram showed 3,650,000 red blood cells per cu. mm. with 10.5 grams of hemoglobin. White blood cell count was 5,150 per cu. mm. with 40 granulo-

cytes, 56 lymphocytes and 5 monocytes. Urinalysis showed some albumin and only rare white cells.

Course and Treatment: The patient was taken to surgery on September 9. A large skin flap was dissected free from the superficial fascia on the right side of the neck. Numerous and extensive venous sinuses containing bright arterial blood in the posterior triangle of the neck were dissected free. The clavicular portion of the sternocleidomastoid muscle was sacrificed. Approximately 1250 cc. whole blood were given during the surgery. Patient's immediate postoperative recovery was good. She regained consciousness early in the evening of the day of surgery and spoke distinctly and easily. She was able to take oral fluids immediately. She was maintained on SR Penicillin and dihydrostreptomycin daily. The patient had considerable drainage from the wound area and required an additional 250 cc. whole blood on September 10. The hemoglobin on September 15 was 13 grams per cent. She made a good postoperative recovery and remained afebrile. Most of the sutures were removed prior to discharge and the wound was healing fairly well.

Final diagnosis: Congenital arteriovenous communications, multiple, of head, face, mouth, neck and chest.

Operation: Excision, radical, of congenital arteriovenous communications of neck.

Condition on discharge: Improved. This patient was discharged on Sept. 20, 1955.

Case 6. J. E. G., an 8 year old boy, was admitted to the hospital on Feb. 9, 1954.

History: On Dec. 2, 1953 a soft compressible mass on the left cheek was removed surgically. **Diagnosis:** Congenital arteriovenous fistula, face. On his second admission to the hospital, on Feb. 9, 1954, the child's mother gave the history that 1 year previously the swelling in the left face had begun to recur and during the past month had grown rapidly.

Examination: Right cheek was normal. There was a diffuse enlargement of the left cheek which extended from the zygoma down to the ramus of the mandible, posteriorly to the ear and anteriorly almost to the corner of the mouth. This mass could not be compressed.

Operation: On February 10, his second operation was done through a preauricular off the face incision. The mass was explored and found to be made up of hypertrophied muscle tissue only. Little bleeding was encountered.

Pathologic diagnosis: 1. Congenital arteriovenous fistula (first operation). 2. Hypertrophic masseter muscle (second operation).

Course: The asymmetry of the face has persisted with evidence of recurrence of arteriovenous communications in the pterygoid fossa. This patient was discharged from the hospital on Feb. 19, 1954.

Case 7. R. B. T. was a 16 year old boy.

History: In October 1952, the patient incurred a hyperextension injury of the left elbow playing football. Painless swelling developed just above the elbow posteriorly. The swelling disappeared on elevation—reappeared on lowering. An elecranon bursitis was suspected.

Examination: In August 1953, the patient had a soft compressible mass on the lower posterior aspect of the left arm. Moderate telangiectasia and dilated tortuous veins were present in this area. Mass disappeared on elevation of the arm. In October 1953, an arteriogram was made using the left brachial artery which showed increased collateral circulation about the elbow. Oxygen saturation of blood from these dilated veins was 16 vol. per cent (right arm 8.5 vol. per cent). Venogram showed the mass of veins in the area with no obvious arterial connection.

Operation: At the first operation (Aug. 14, 1953) the posterior lower third of the upper arm was exposed and dilated veins up to $\frac{3}{4}$ " diameter were found which carried bright red blood. All vessels in the area were ligated and divided. At the end of the operation no tumor was present.

In January 1954, there was evidence of recurrence of the tumor, accordingly a second operation was done. A posterior medial incision was made on the lower third of the upper arm and carried down on the forearm. Again numerous large vessels were found, ligated and divided. Evidence of fistulas were found within the bone. Some bone was removed as well as the fascia.

Pathologic diagnosis: Arteriovenous fistula, congenital.

Course: No evidence of recurrence. He has earned a letter in college football and currently is on full duty in the Army.

Case 8. M. K., a 23 year old woman, was admitted to the hospital on Jan. 21, 1956.

History: Past 12 to 14 years this young lady had noticed a painful tumor over the left eye. The tumor has varied in size and when it enlarges, the associated pain became more severe. While in a concentration camp several years ago, she gave a history of having been struck on the head although she is not sure that it was in the particular area of the tumor. A throbbing sensation was always present in the area. Above this lesion she has noticed an area in the skin which was pinkish in color and mottled and which seems to vary in size as did the tumor immediately below it.

Examination: Physical examination revealed a compressible tumor just above the left supraorbital ridge which was moderately tender. A branch of the temporal artery was palpated just to the left of this tumor and measured $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. Blood pressure was 120/70, heart sounds were normal and the physical examination was otherwise essentially that of a normal young woman. Electroencephalogram was negative. Roentgenograms of the skull showed no invasion or changes in the cranium. An arteriogram performed under direct vision on February 3 failed to reveal any communication between the arterial and venous side. Some dye was present, however, in a tapering vessel and appeared to enter a vessel of larger caliber distally. This was considered to be suggestive but not diagnostic of an arteriovenous fistula.

Operation: At operation on Feb. 6, 1956 the tumor was excised. Considerable bleeding from every direction was encountered during the procedure and it was necessary to replace lost blood with two transfusions of 500 cu. cm. each. Bright red blood was encountered uniformly during the procedure. The tumor itself measured approximately $1\frac{1}{4}$ inches in diameter.

Pathologic diagnosis: The tissue removed was skeletal muscle and areolar tissue with angiomatous foci. The sections are consistent with arteriovenous fistula.

Course: No pain has been noted in the area since the operation and the throbbing has ceased. The compressible tumor is gone and the area of telangiectasia located above the tumor has disappeared.

Case 9. M. A. C. was a 41 year old woman.

History: Patient had a shadow in the left lung field for a period of about 8 years. Old roentgenograms from year to year showed very little change in this shadow at the base of the left lung. Patient complained of some dyspnea on exertion and chest pain. She did not have any history of hemoptysis.

Examination: There was a murmur at the base of the left chest posteriorly but it was not clearly audible. Blood pressure was 90/50. Otherwise the examination was essentially negative.

Operation: An incision was made over the sixth rib on the left side. On opening the chest, and palpating the lower lobe, a definite thrill could be felt which was stopped on compression of the pulmonary artery. No mass was felt. There were blotchy areas of dilated vessels about $\frac{1}{2}$ cm. in diameter studded throughout the surface of the left lower lobe. The pulmonary artery was dissected out and was quite markedly dilated. The lobe was removed by individual ligation technic, underwater seal suction drainage was established and the incision was closed.

Pathologic diagnosis: Arteriovenous fistula, left lower lobe of the lung.

Course: Since the operation the patient has gotten along very well. She complains of chest pain but otherwise her general condition is excellent.

SUMMARY

Congenital arteriovenous communications often are incorrectly referred to as hemangiomas. They may occur anywhere in the body. Complete excision of the involved area produces the best results. When this is impractical, as in an ex-

tremity, ligation of the veins and excision of small areas containing obvious communications may control the lesion. Infants have more localized lesions, therefore respond better to treatment. The saving of life or limb and the prevention of great disability are the usual goals when arteriovenous communications are present. An aggressive surgical approach and considerable perseverance are warranted.

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HEMOSTASIS AND VESSEL REPAIR: A UNIVERSAL SURGICAL RESPONSIBILITY

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Until recently the performance of vascular surgery has been the exclusive province of a limited group of surgical specialists. Within the past few years more general use of the technics involved in the repair of blood vessel injuries and vessel replacement for other reasons has brought this field into the realm of the general surgeon. It is no longer justifiable for any surgeon needlessly to sacrifice an injured blood vessel that might otherwise be saved by the application of standard vascular surgical technics. At the present time, the physician who assumes the responsibility for the definitive management of the injured should be equipped to recognize and deal with the problems of blood vessel injury, thus avoiding needless loss of life or limb.

The purpose of this paper is to review some of the basic principles of vascular surgical technic which should be familiar to all surgeons; to emphasize their application in properly maintaining hemostasis; and to demonstrate their life and limb saving application in the management of acute vascular injuries.

A. Ligation of Vessels: The ligature used to secure a bleeding vessel should be adequate to hold, but of sufficiently small diameter to minimize foreign body reaction. Under standard conditions the tensile strength of a ligature varies as the square of its diameter or as its cross sectional area (fig. 1). In practice the surgeon usually employs ligatures larger in diameter than are actually necessary. Although the bursting strength of a ligature encircling a vessel is but 70 per cent of the outstretched strand (fig. 2), its holding power can be greatly increased by care in its meticulous placement. The bursting strength of a ligature varies as the square of the radius (i.e., the cross sectional area) of the tissue which it encircles (fig. 3). Thus, a small caliber ligature may well break if it encloses not only a vessel but several millimeters of surrounding soft tissue, whereas the same suture will hold with adequate reserve tensile strength if only the vessel itself is encircled.⁸ Such Halstedian technic also minimizes ischemic destruction of perivascular tissues, and lessens the chance of the vessel slipping out of the ligature.

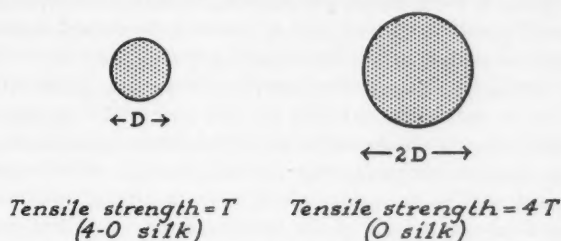
Each throw of the knot should be carefully placed—a difficult procedure if a one-handed tie is employed. The knot should be placed perpendicular to the axis of the vessel, for obliquely placed ligatures often work loose (fig. 4). This hemostatic principle is of primary importance in the control of large arteries, but it is equally applicable to the ligature of smaller vessels.

A square knot is superior to a granny knot which may slip and allow bleeding (fig. 5). Only when 3 throws instead of 2 are used can a granny knot be made as

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secure as a square knot.⁸ However, to avoid slipping it is always safer to use 3 throws when silk ligatures are employed.

If sutures are cut exactly at the edge of the knot they may pull free when increased tissue swelling occurs. To avoid this, an optimal compromise may be



Tensile strength of suture varies
as square of its diameter

FIG. 1

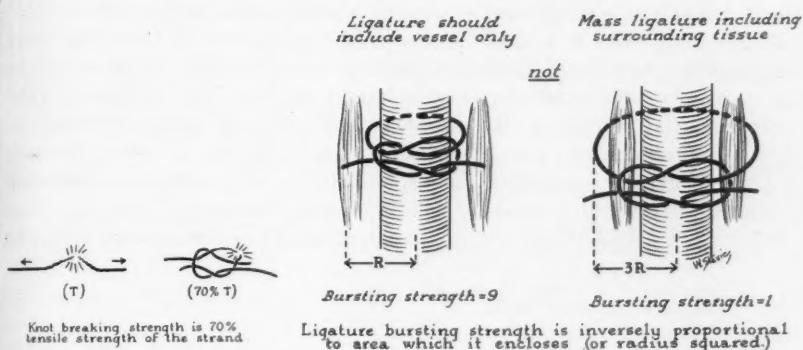


FIG. 3

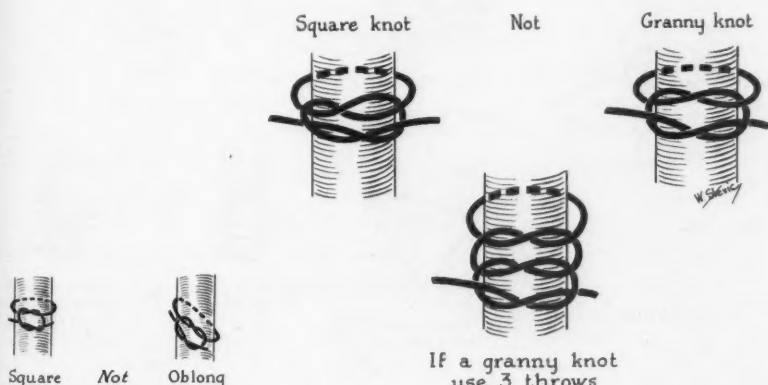


FIG. 4

FIG. 5

obtained between the safety of a long tag and the hazard of a tie cut too closely, by leaving a 2 millimeter tip extending beyond the knot border (fig. 6). This length can be achieved by steadying the scissors with both hands, sliding the tips of the scissors to the knot, and angling the blades 45 degrees before cutting.

Encircling ligatures are adequate for securing hemostasis of small vessels, but a combination of a suture ligature and a proximal tie should be employed to avoid dislodgement of the suture by arterial pulsation or tissue manipulation in vessels the size of the left gastric or splenic arteries (fig. 7). In larger vessels, such as the iliac or subclavian arteries, an over-and-over everting stich of no. 0000 or no. 00000 arterial silk should be employed, because simple encircling ligatures or suture ligatures may well erode through the walls of such large arteries. Where such large arteries are atherosclerotic, an encircling ligature may often cause fragmentation and tearing of the brittle calcific vessel wall and result in disastrous hemorrhage. The pulsating end pressure of such large arteries is far greater than the lateral pressure, so that closure must be attained by the most secure method possible. A continuous everting suture over the open end of the vessel not only provides such a closure but also helps to preserve adjacent collateral channels which might be occluded by a heavy encircling ligature (fig. 8).¹⁰

B. The Recognition of Arterial Injuries Following Trauma: Concern over local soft tissue or bone injury following trauma may prompt the inexperienced physician to overlook the possibility of concomitant vascular injury. Such a course results in a delay in diagnosis that eventually may mean the loss of an extremity. Since major vascular injury must be dealt with as an emergency before irreversible ischemic damage occurs, it is the responsibility of every physician examining an injured extremity to be alert for signs of vascular damage.

When a compound injury occurs, associated major vascular damage is readily

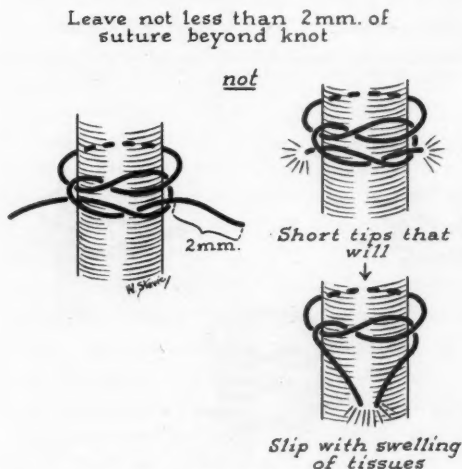


FIG. 6

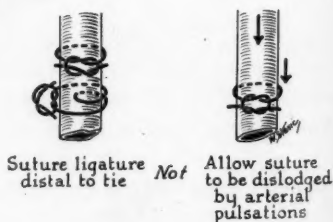


FIG. 7

identified. Less easily recognized in the open wound, however, is a major arterial trunk temporarily closed by spasm following its complete severance by a blunt, penetrating force (fig. 9). Conversely, an incomplete laceration of a vessel results in profound hemorrhage that may not cease spontaneously because the vessel wound is held open by retraction of its lacerated margin.¹

Vascular damage following nonpenetrating trauma is more frequently overlooked, but only because it is less often considered. The same signs of vascular insufficiency—pain, pallor and loss of pulsation—appear regardless of the etiology of the trauma.

Such nonpenetrating trauma over a major vessel can produce vascular occlusion in several ways. A perivascular hematoma combined with vascular spasm from injury of the vessel wall may produce complete obliteration of the lumen and ultimately lead to an organized local thrombus (fig. 10).

Less common, but equally serious, is the arterial obliteration resulting from acute interstitial edema within an enclosed fascial space. When such swelling

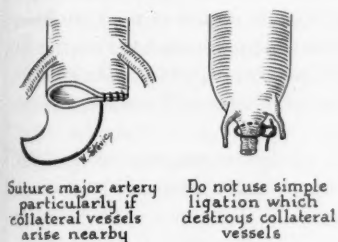


FIG. 8

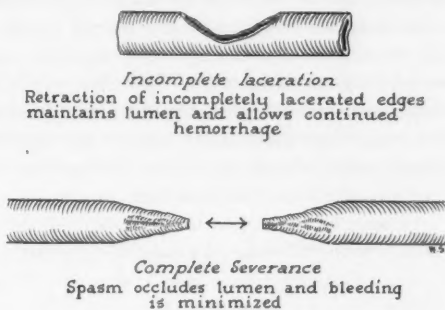


FIG. 9

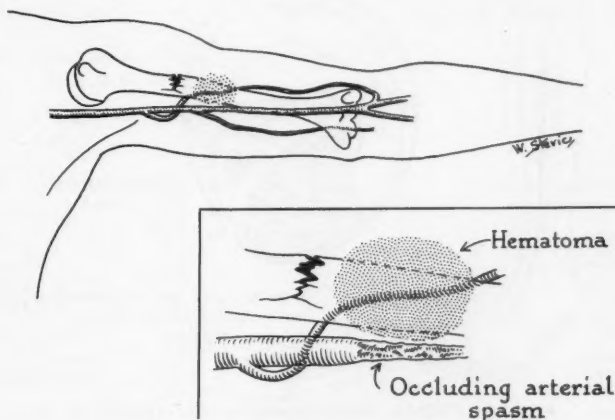


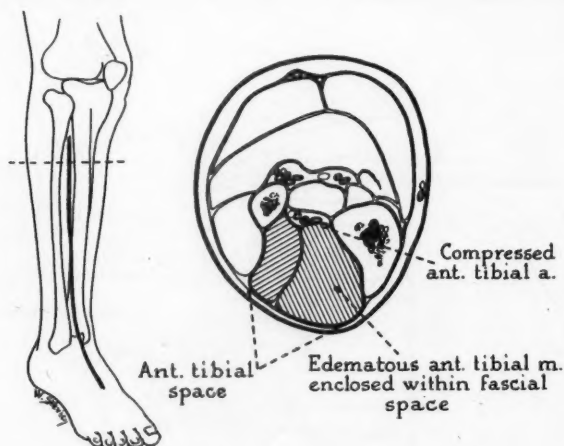
FIG. 10

occurs within a rigid fascial envelope any contained blood vessels are compressed and blood flow interrupted. The most frequent site of such compression is within the anterior tibial space and may result from nonpenetrating, crushing trauma or even following severe and unaccustomed exercise⁵ (fig. 11). Fracture may be absent, and the only clinical signs may be of severe arterial insufficiency. Sympathetic interruption in an attempt to increase blood flow is obviously of no value, but simple fasciotomy will decompress the area of acute edema and dramatically restores the vascular supply of the extremity.

C. Wound Priority in Vascular Injuries: A life threatening hemorrhage ranks in priority with respiratory embarrassment in the management of the injured. External bleeding of such nature is seldom overlooked and can be temporarily controlled by finger or sterile gauze compression (fig. 12). Only occasionally is a tourniquet required, and if used, should be released every 2 hours, by which time adequate transfusion therapy should be available.

More commonly, blood vessel injuries result in blood loss of less dramatic proportions and once the bleeding is controlled the vascular damage assumes less immediate priority. As in any wound shock must be adequately treated before operative measures can be undertaken for organ repair. Failure to repair a blood vessel may result in loss of limb, but operative meddling on a patient in shock may result in loss of life. Only in the rare situation where hemorrhage cannot be controlled by conservative measures is operative repair of a vessel indicated on the patient in shock. In such an instance operation may be considered a resuscitative measure to control bleeding.

As soon as shock has been controlled and life saved the surgeon can concern himself with the limbs and should at the earliest opportunity attempt blood vessel



ACUTE EDEMA WITHIN FASCIAL SPACE
PRODUCING ARTERIAL OCCLUSION

FIG. 11

repair. The length of time that a limb remains viable after severance or occlusion of one of its major vessels depends upon the vessel injured, the extent of the collaterals, presence of pre-existing obliterative disease, and the amount of distal arterial spasm or thrombosis. In general, repair of a vessel critical for limb survival must be accomplished within 4-6 hours after injury. When symptoms of ischemia appear as a late complication of vascular injury, exploration and vascular repair may be beneficial weeks or months following trauma.

D. Debridement, Infection and Soft Tissue Coverage: Meticulous wound toilet and debridement is necessary for successful vascular repair following trauma. Blood vessel anastomosis will subsequently disrupt if surrounded by nonviable tissue or by infection (fig. 13). A vascular anastomosis line and, in particular, a vascular graft, must be surrounded by firm, healthy, well vascularized soft tissue. Vascular homografts act only as a temporary conduit and nonviable framework for subsequent tissue replacement by the host and therefore depend upon the support and viability of surrounding soft tissue. In vascular injuries in the extremities the repaired vessel usually can be covered by intact healthy muscle, but under all circumstances it must not be left exposed (fig. 14) or surrounded by tissue of questionable viability.

Because infection is such a major threat to a vascular anastomosis primary closure of the overlying wound is greatly to be desired. When there is question of infection, the wound should be left open with the anastomosis covered by healthy tissue, but if debridement is adequate primary closure in civilian practice at least may be employed. Vigorous pre and postoperative systemic antibiotic therapy should be employed.

The blood vessel itself must be debrided following laceration, for in such instances the injuring force usually damages the vessel for a varying distance on each side of the actual defect (fig. 15). At the time of debridement a short segment of vessel on each side of the vessel should be excised to assure anastomosis through undamaged vessel. The extent of such excision will depend on the nature

MASSIVE HEMORRHAGE FROM MAJOR VESSELS SHOULD BE CONTROLLED

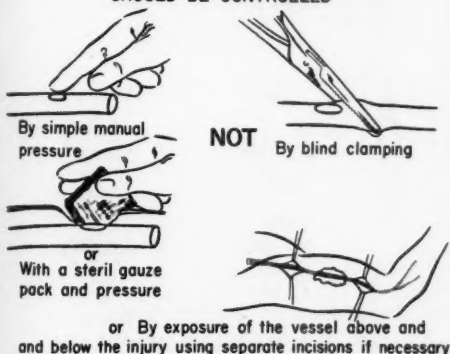


FIG. 12

THE GRAFT OR ANASTOMOSIS LINE

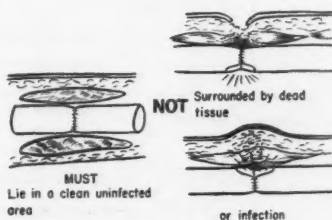


FIG. 13

of the injuring force; blunt tearing trauma and high velocity missiles both result in damage far beyond the obvious confines of the wound. The dynamics of the former are obvious. The ballistics of high velocity missile injuries indicates that they impart much of their force laterally on the surrounding tissue, producing an explosive effect within the tissues and producing tissue damage at a distance from the wound.

Excision of damaged vessel must not be compromised in an effort to attain a primary anastomosis rather than insertion of a graft. Similarly, a vascular anastomosis must not be performed with the ends under undue tension, lest they separate in the succeeding days when the tissues holding the sutures weaken (fig. 16).

E. Treatment of Nonpenetrating Injuries: The treatment for vascular obliteration following nonpenetrating trauma is early operation before irreversible ischemic damage supervenes.^{6, 9} Decompression of the wound surrounding the injured vessel and evacuation of surrounding hematomata may release tissue pressure and reduce vasospasm. Local application of 1 per cent procaine or 1 per cent papaverine may further reduce such arterial spasm. Regional sympathetic block or concomitant sympathectomy are useful supporting procedures in such instances. Should an intraluminal thrombus exist it can be evacuated before irreversible ischemic damage occurs or the thrombus propagates.

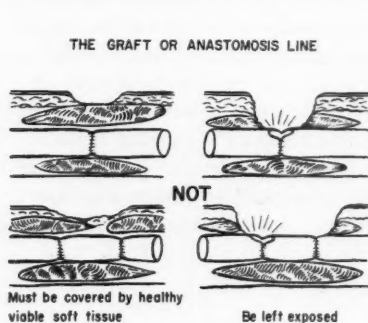


FIG. 14

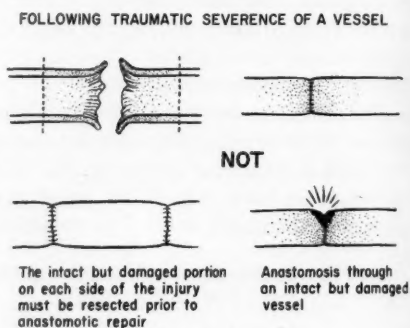


FIG. 15

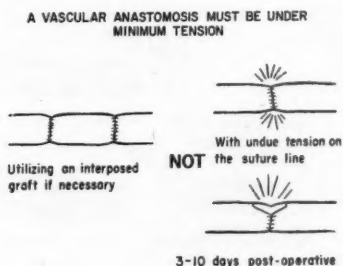


FIG. 16

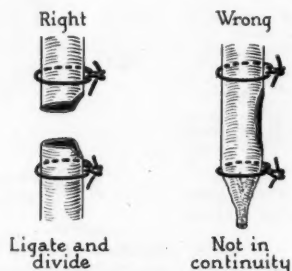
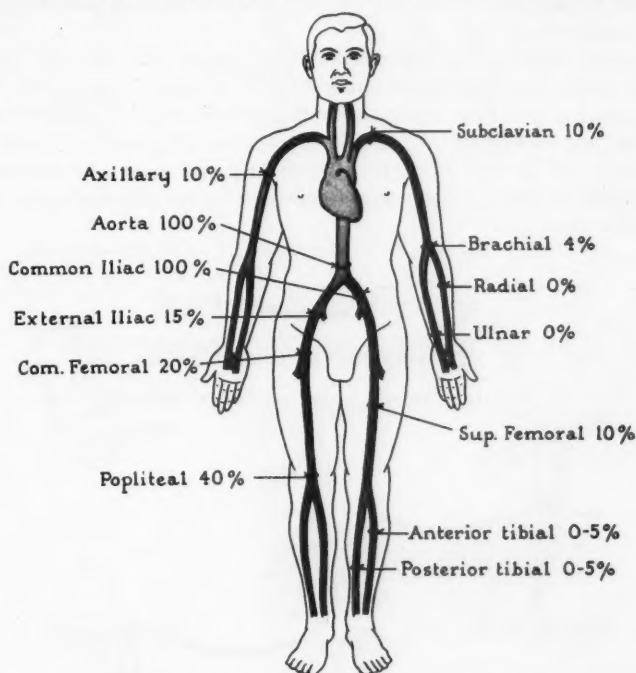


FIG. 17

Occasionally such an injured vessel cannot be saved or its patency restored. In such a situation when ligation is unavoidable, the vessel should not be ligated in continuity. Instead, a small segment should be excised, so as to interrupt the periarterial sympathetic nerve fibers running through the section of damaged artery. This will avoid troublesome vasospasm distal to the point of injury (fig. 17)³.

F. The Closure of Vascular Lacerations: Whenever possible vascular continuity should be restored if a traumatic or inadvertent surgical defect has occurred⁹. Ligation of the artery merely because it is lacerated may produce irreversible gangrene of the organs or extremity beyond the point of injury. These critical points of ligation (fig. 18) which may lead to distal gangrene should be familiar to all surgeons so that arterial occlusion at these levels can be avoided^{2, 7}. It should also be appreciated that sacrifice of major arteries or veins may produce disabling symptoms of arterial or venous insufficiency even though gangrene does not result.

The repair of a traumatic or operative rent in a major blood vessel producing massive bleeding requires a variation in the surgeon's usual technical and mental



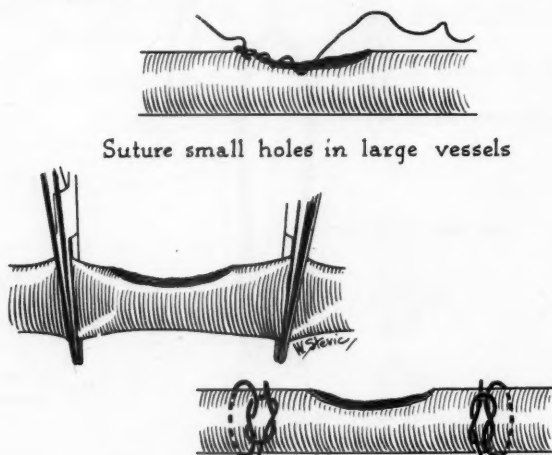
EXPECTATION OF GANGRENE AFTER ARTERIAL LIGATION
(After Pratt, G.H., *Cardiovascular Surgery*, 1954)

FIG. 18

approach to such a problem. Rather than sacrificing the vessel by applying a large hemostatic clamp, the surgeon must temporarily control the hemorrhage with manual compression or with umbilical tapes or vascular clamps placed around the vessel above and below the wound, and then proceed to repair the defect. Occasionally exposure of the vessel proximal and distal to the site of injury will necessitate separate incisions (fig. 12).

If controlling umbilical tapes can be placed proximally and distally the hole can be repaired in a dry field. If not, the area of compression gradually can be diminished until only a fingertip covers the defect. A no. 0000 or no. 00000 arterial suture can then be started in the vessel at the periphery of the laceration just beyond the compressing fingertip covering the hole. By exerting traction on the short end of the suture, the edge of the hole can gradually be exposed beneath the occluding finger and closed with an over-and-over everting suture (fig. 19). Such technic minimizes blood loss and yields adequate exposure. An open tip suction should be available and adequate blood replacement utilized. Simple suture of such a vascular laceration should be performed only following surgical injury of a vessel. Following accidental trauma the vessel is usually damaged far beyond the obvious confines of the laceration and wide debridement should be employed.

Occasionally, following severance of an artery, repair may be made by simple end-to-end anastomosis, using a running or interrupted everting stitch (fig. 20). Following trauma it is more common for the severed vessel to retract from the wound edge, and to require further debridement back to healthy arterial tissue. In the presence of such a defect the ends of the vessel cannot be approximated without undue tension, primary anastomosis is inadvisable and some type of graft must be employed.



Suture small holes in large vessels

Do not sacrifice the vessel

FIG. 19

Numerous types of grafts have been employed, one of the simplest and most effective of which is a segment of reversed autogenous saphenous vein. Such grafts are anastomosed to the severed ends of the artery, using an everting mattress or simple running stitch (fig. 21), which usually is interrupted 2 or 3 times around the circumference of the vessel to avoid narrowing of the anastomosis line⁴. The operative technic in vascular graft anastomosis, although not very difficult to perform, obviously requires practice and experience. In par-

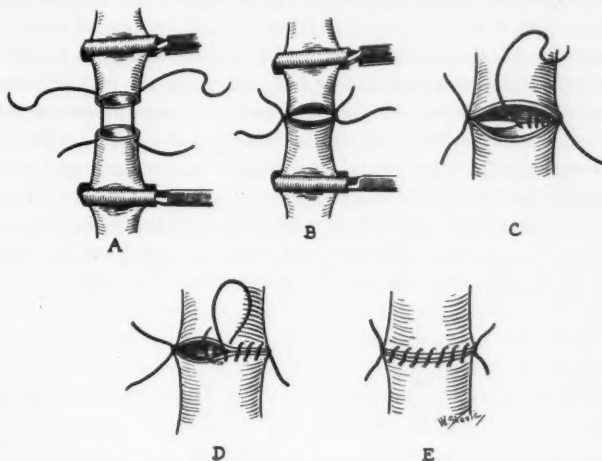


FIG. 20

USE OF GRAFT TO BRIDGE VASCULAR DEFECT

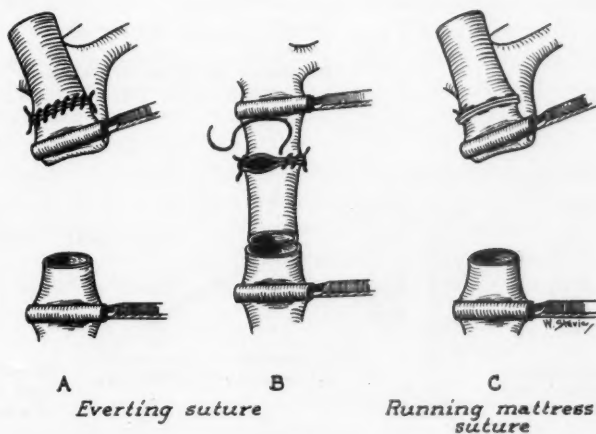


FIG. 21

ticular, there are details both in the operative and postoperative management of such patients that require meticulous attention and some specialized experience in order to obtain optimal results.

If a severed artery must be sacrificed following trauma, care should be taken to ligate the distal end of the vessel, for severe postoperative hemorrhage can result from the open end of a vessel that remains closed by spasm during debridement but thereafter bleeds when vessel spasm diminishes (fig. 22). The proximal end is usually bleeding and is easily located, while the distal end may be overlooked.

The ligature about such an injured artery should be placed close to the first major collateral branch, thus avoiding a long expansile arterial cul-de-sac which absorbs the pulsatile force of the artery and minimizes the pulsatile thrust of the blood through collateral channels (fig. 23). Placing the ligature immediately below the first arterial branch will assure the development of optimal collateral supply.

Neither experimental nor clinical observation has supported the contention that the accompanying vein should be ligated when a major artery necessarily is sacrificed^{3, 9, 11}. Such a maneuver merely increases the possibility of venous insufficiency and in no way improves the vascular supply of the involved extremity. The accompanying vein should be left intact (fig. 24).

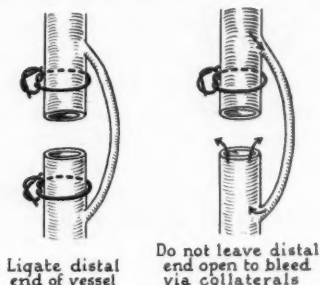


FIG. 22

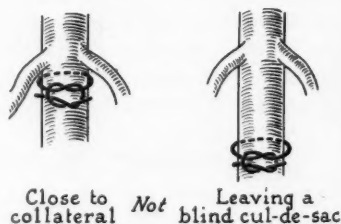


FIG. 23

FOLLOWING VASCULAR SUTURE WHERE THERE MAY BE MOTION OF THE ANASTOMOSIS LINE

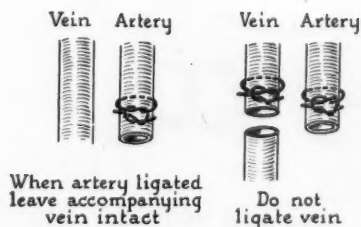


FIG. 24

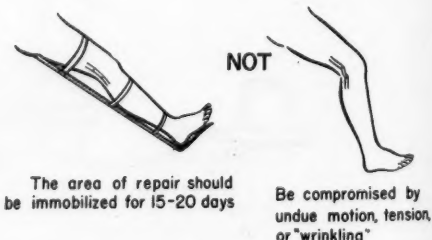


FIG. 25

G. Postoperative Care: Following the repair of a vascular defect, all available measures must be taken to avoid infection by the use of adequate antibiotic therapy. Immobilization of the anastomosis line should be employed (fig. 25) for a period of 7-10 days if the graft or anastomosis is situated where movement is possible. If there is a possibility of ischemia peripheral to the vascular repair, sympathetic interruption either by sympathetic ganglionectomy, repeated sympathetic procaine blocks, or a continuous caudal anesthesia should be employed. Sympathectomy is of particular value where arterial interruption has necessarily been prolonged and tissue viability is in doubt.

The routine use of anticoagulant therapy following the repair of vascular injury is of debatable value. In arterial injuries if an adequate blood flow is attained through the injured segment, anticoagulants will rarely be of value in preventing thrombosis. Following suture repair of venous injury there is no doubt that vigorous anticoagulant therapy should be employed at the earliest moment in order to avoid venous thrombosis and possible pulmonary embolization. If the other wounds permit, heparin should be used as soon after wound closure as is possible. Oral anticoagulants may be employed thereafter.

Following the repair of vascular injuries the extremity should be wrapped in protective cotton batting, be elevated slightly on one pillow, and be covered by a cradle without heat. Repeated manual palpation and manipulation of the extremity should be avoided. Frequently there is a period of temporary peripheral vasospasm immediately following such vascular repair, resulting in a pale, pulseless and cool extremity, the viability of which is questionable. Fortunately, within a few hours this vasospasm often disappears and the signs of ischemia diminish.

Discussion and Conclusion: Arterial insufficiency following either penetrating or nonpenetrating trauma to an extremity, should be treated by surgical exploration as soon as the general condition of the patient permits. The vast majority of such vascular injuries are seen by physicians who are not especially trained in vascular surgery. This is no longer an excuse for delay in recognizing these injuries, which, if unattended, may result in loss of life or limb. The vast majority of operative and traumatic injuries to large arteries and veins can be repaired without sacrificing the involved vessel. The surgical techniques employed in the repair of most vascular injuries are well within the technical scope of most well trained surgeons of whatever subspecialty.

Any physician who is responsible for the management of an injured person must be able to recognize the signs of arterial insufficiency in an injured extremity. Any physician who presumes to manage such an individual by surgical means should be familiar with the principles of vascular surgery, including the principles of arterial repair and a familiarity with the various types of trauma that may produce arterial insufficiency.

SUMMARY

The surgical principles involved in the proper recognition and the technical aspects of operative management of vascular injuries have been reviewed.

It has been emphasized that these technics must be mastered by the surgeon who assumes the responsibility for the management of the injured. No longer are they the sole province of the vascular surgeon.

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THE USE OF TANTALUM MESH FOR DIFFICULT ABDOMINAL CLOSURE

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The modern surgeon is prepared to undertake operative procedures which his predecessors would have thought foolhardy or even impossible. The broadened scope or radical, supraradical and "second look" surgery, however, has offered many patients the opportunity for prolonged life free of suffering and extended invalidism as compared to a decade or more ago. Many factors have aided the surgeon in successfully completing so-called "inoperable" cases, important among which has been the utilization of artificial material for tissue replacement. Into this category falls the use of Tantalum mesh as a means of closing the abdominal wall when approximation would otherwise be impossible. It is, indeed, a disheartening experience to be faced with a surgical situation in which removal of diseased tissue which has extended into the abdominal wall precludes the completion of the operation because final closure of the wound can not be carried out. An interesting patient, recently operated upon by us at St. Luke's Hospital in Chicago, demonstrates one of the means by which this problem may now be resolved.

CASE REPORT

The patient was a 54 year old Negro Pullman porter who was admitted to St. Luke's Hospital, Chicago, Illinois, for the first time on Jan. 20, 1955, with a complaint of nausea and vomiting for a period of 5 months. This had become progressively more severe during the 2 weeks just prior to admission. At the time of admission, the patient was unable to retain anything in his stomach. A swallow or two of water or tea would be regurgitated within a few minutes. There was no pain associated with the vomiting and except for weakness, dizziness and a 30 pound weight loss over a period of 3 months the patient had no other complaint. He had been in good health until the time when the vomiting started.

Physical examination revealed a dehydrated and somewhat emaciated Negro man who was cooperative and did not appear to be in any pain or distress. Physical examination was essentially normal with the exception of a mass which was palpable in the epigastric area and which was nontender and movable. His red blood cells were 4,100,000 per cu. mm.; hemoglobin 11.2 Gms.; and leukocytes 6,100. Urinalysis was negative. The nonprotein nitrogen was 25; blood sugar 96 mg. per cent; serum sodium 141.5 meq/L; serum potassium 4.00 meq/L; CO₂ combining power 60.7 volume per cent; sedimentation rate 56 mm. in 60 minutes. The Wasserman test for syphilis was strongly positive.

A Levin tube was placed into the patient's stomach and constant suction was applied. Approximately 700 cc. of material was aspirated each twenty-four hour period. The patient was supported with intravenous fluids. A specimen of the gastric aspiration was reported as containing 17 units of total, 11 units of free and 6 units of combined acid. On January 24 a small amount of thin barium was given to the patient by mouth and a diagnosis of a large polypoid carcinoma of the antral portion of the stomach with complete obstruction was established.

From the Surgical Service of St. Luke's Hospital and the Department of Surgery, Northwestern University Medical School.

The patient was prepared for surgery and on January 29, 1955, exploratory laparotomy was carried out. An upper abdominal transverse incision was made and the peritoneum was entered with ease. The abdominal viscera were normal with the exception of the stomach which contained a large cauliflower-like lesion in the antrum. There were no local or distant metastases and, therefore, a radical subtotal gastric resection was undertaken. A Hofmeister modification of the Billroth gastrojejunostomy was carried out. The patient tolerated the procedure well and made an uneventful recovery. He was discharged from the hospital on the eighteenth postoperative day. The final pathologic report was a colloid carcinoma of the stomach with microscopic invasion of the perigastric tissue.

The patient was followed for 13 months in the out-patient Clinic with no complaints. He gained 8 pounds in weight and was able to eat without distress. In March of 1956, however, he began to experience a feeling of fullness in the epigastrium and his vomiting recurred. A mass became palpable in the abdomen and several nodules were discovered in the scar from his previous operation. In April he became clinically jaundiced and on April 15, 1956 he was re-admitted to St. Luke's Hospital for evaluation.

On the second admission the patient appeared to be in a much better state of health than he had been at the time of his previous hospital discharge. He was alert and cooperative although dehydrated and jaundiced. The physical examination was normal with the exception of a sense of fullness in the epigastric area. Several hard, tender nodules 1 by 1 cm. were palpable in the upper abdominal transverse scar. His red blood cells were 2,970,000; hemoglobin 9.6 grams; leukocytes 19,800; urinalysis was normal except for the presence of bile. Alkaline phosphatase 36.1 units; total bilirubin 11.70 mg. per cent, 5.15 mg. per cent bound and 6.55 mg. per cent free. His temperature was normal.

Gallbladder roentgenograms revealed nonvisualization and an upper gastrointestinal study with barium showed no evidence of obstruction or recurrence of the tumor. Chest film and flat plate of the abdomen were normal. On April 20, 1956, re-exploration was carried out. The old incision was excised in an elliptical fashion and dissection carried down into



FIG. 1. Showing the mass of recurrent carcinoma with the entire thickness of the anterior abdominal wall and the segment of transverse colon resected.

the abdominal cavity. It was found that a mass of tumor tissue extended upward from the posterior peritoneal area, below the gastroenterostomy and involved the head of the pancreas and the porta hepatis. The transverse colon was infiltrated by this mass of tissue. There was no evidence of hepatic involvement and the remainder of the abdominal cavity was free of tumor. The entire tumor was removed en bloc, including all layers of the abdominal wall, and as much of the tumor as possible from the porta hepatis. Approximately 4 inches of the midtransverse colon was removed with the specimen (fig. 1). Because of the extension of the tumor, it was impossible to undertake any type of decompression of the biliary tree. At the completion of the procedure, the defect in the anterior abdominal wall measured approximately 6 by 8 inches with no available fascia for closure. The skin was undermined for several inches in all directions and with a fair degree of tension it could must be approximated. Twenty-four gauge stainless steel wire was placed $1\frac{1}{2}$ inches apart as through and through tension sutures but, despite considerable effort, the wound edges would not come together. A piece of tantalum gauze (50 by 50 mesh) measuring $3\frac{1}{2}$ x 5 inches was then sewn to the edge of the anterior fascia, directly over the open abdominal cavity, and the skin was approximated with interrupted silk sutures over this. A Penrose drain was placed beneath the skin down to the tantalum mesh and the tension sutures were tied (fig. 2). The patient was returned to his room in fair condition after having been on the operating table 3 hours and 50 minutes.

Postoperatively he made a slow but uneventful recovery. The abdomen drained bile-stained serum copiously for about 14 days and then subsided to less than 10 cc. daily for the



FIG. 2. Roentgenogram of the abdomen, taken on the twenty-first postoperative day, showing the tantalum mesh in place.

remainder of his hospital stay. The wound healed firmly and without slough and when the patient was allowed out of bed on the tenth postoperative day there was no evidence of herniation or weakness of the abdominal wall. Every other tension suture was removed on the twenty-fourth day and he was discharged from the hospital on the twenty-fifth day. The remaining stainless steel tension sutures were removed from the wound on the thirtieth postoperative day and no weakness or disruption of the incision was noted. There was a "spot" of drainage on the dressing at the time that the last sutures were removed.

When seen 3½ months later, he was ambulatory and relatively free of distress. He continues to be jaundiced, but is eating well and having normal bowel movements. His wound is firm and is draining less than 1.0 cc. of amber, noninfected serum each day.

DISCUSSION

For many years surgeons have been seeking a material which could be used to bridge structural defects in the abdominal wall.^{1, 12} Although a great many substances have been used and advocated, the trial of time has sentenced most of them to disrepute and they have been discarded for one reason or another. Recently, however, a number of investigators have reported quite favorable results with the use of tantalum mesh as a splint for supporting the abdominal wall when the existing tissue could not be utilized for a safe or adequate closure.^{2, 3, 4, 5, 6, 9, 11} Tantalum has been found to be resistant to infection and is superior to the other commonly used metals in stimulating a normal fibroblastic reaction and producing a soft, pliable wound.^{7, 8, 10} As tantalum is an element (Atomic number 73 and atomic weight 180.88) and not an alloy, it is relatively inert in the chemical environment of the tissue and electrolytic action in body fluids is reduced to a minimum.

The enthusiastic reports of the excellent results obtained by those who have used tantalum as an aid in repairing large hernias of various types would indicate that it must be considered a part of the surgeon's armamentarium in his approach to the difficult and unusual cases. We could, however, find no mention in the literature of its being used to close a surgically produced defect in the abdominal wall when the nature of the operation dictated removal of a considerable portion of the skin, muscle, fascia and peritoneum. While the procedure herein reported was admittedly of a palliative nature, the patient has been allowed to live an ambulatory life, free of suffering and constant attention, an existence which is highly unlikely had tantalum mesh not been available. There is no reason to doubt that the material also may be a valuable means of repairing acute tissue defects resulting from burns, infections or trauma.

SUMMARY

Tantalum mesh has been used successfully to repair a large defect in the abdominal wall resulting from the removal of a recurrent mass of carcinomatous tissue from the anterior peritoneum along with the entire thickness of the overlying structures. The mesh was placed directly against the underlying transverse colon and was covered by skin alone. The patient is ambulatory and has shown no evidence of postoperative hernia 3½ months after the operation.

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A CRITICAL EVALUATION OF THE BILLROTH II TYPE GASTROJEJUNOSTOMY

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Forty-four patients subjected to $\frac{2}{3}$ to $\frac{3}{4}$ gastric resection and Billroth II type gastrojejunostomy are presented for study. Each was personally operated upon and followed from a minimum of 1 to a maximum of 5 years postresection. One patient who had unsuspected early gastric carcinoma is included; the remainder had benign gastric or duodenal ulceration or both. This experience was gained in successive, unselected cases in an effort to evaluate the Billroth II type gastrojejunostomy. I have tried to neither whitewash the poor results, nor condemn the good.

Reliable evidence exists^{6,7} that the Billroth I operation offers certain advantages over the procedure under consideration. The author believes however that the Billroth II procedure is not only satisfactory, but safer in certain situations. The assets and liabilities of this operation are stated hoping to contribute to the evidence that will help the surgeon decide when this procedure may be best used. There is divided opinion as to whether gastric resection is even the procedure of choice when surgical intervention becomes necessary in the treatment of peptic ulcer. Poth⁴ and Dragstedt¹ are notable exponents of other forms of surgical treatment. At the present time, no operative procedure regularly yields entirely satisfactory results. The smattering of excellent results attained by several forms of surgical therapy of this disease has, no doubt, stimulated continued study of this problem. In this paper, no attempt is made to promote gastric resection as a panacea for peptic ulcer. The fact that this procedure has, and still does, enjoy wide popularity, is sufficient evidence to justify further evaluation of the variations of the operation.

CLINICAL MATERIAL AND THE OPERATIVE PROCEDURE

Reference to tables I and II reveals the pathologic diagnoses and their distribution according to age and sex. These statistics do not differ greatly from those reported by hosts of others discussing peptic ulceration, and need only to be recorded without comment.

Indications for surgery in the patients of this series were intractability, hemorrhage, previous perforation, obstruction, gastric ulcer, and various combinations of these manifestations. Hemorrhage, perforation⁵ and obstruction are clinically obvious. Intractability, or failure of medical management, if used as an indication for surgery needs to be strictly defined. About $\frac{1}{3}$ of this group was operated upon with the single diagnosis of intractability, but only after repeated roent-

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TABLE I
Diagnoses, distribution according to sex

Diagnoses	Male	Female	Total
Duodenal ulcer.....	34	5	39 (90%)
Gastric ulcer.....	0	2	2 (4%)
Gastric and duodenal ulcer.....	0	2	2 (4%)
Gastric carcinoma.....	1	0	1 (2%)
Totals.....	35 (80%)	9 (20%)	44 (100%)

TABLE II
Diagnoses, distribution according to age

Diagnoses	No. Cases	Oldest	Youngest	Average Age
Duodenal ulcer.....	39	77	30	51
Gastric ulcer.....	2	70	68	69
Gastric and duodenal ulcer.....	2	42	28	35
Gastric carcinoma.....	1			51

TABLE III
Indications for surgery

Indication	Per cent of Total
Intractability.....	32%
Hemorrhage.....	10%
Intractability and hemorrhage.....	18%
Intractability and obstruction.....	12%
Intractability and previous perforation.....	12%
Intractability, previous perforation and obstruction.....	2%
Intractability, previous perforation and hemorrhage.....	10%
Gastric ulcer.....	4%

genologic studies showed failure of the ulcer to heal, and repeated attempts by medical colleagues, with hospital care and truly good medical management, failed to relieve the pain. Thus, strictly defined, and within the limits of human error, intractability or failure of medical management in this series meant an ulcer which had perforated all the layers of the duodenal wall, but which had been prevented from bleeding by pure chance or from perforation into the free peritoneal cavity by the pancreas posteriorly or some adjacent viscus anteriorly.

All gastric ulcers, and all but one of the duodenal ulcers in this series were removed with the operative specimen. At least 2 centimeters of duodenum were removed to avoid any chance of leaving behind a fragment of antral mucosa which extended beyond the pylorus. The duodenal stump was closed with 2 rows of fine gastrointestinal chromic, and 2 rows of interrupted fine silk. No clamps were used on the duodenum. The gastric remnant was closed from the

lesser curvature to the anastomosis with 2 rows of gastrointestinal chromic and 1 row of interrupted silk. The gastrojejunostomy was made with 1 row of continuous fine chromic and 1 row of interrupted fine silk. In making the anastomosis, the afferent limb was sutured to the greater curvature side creating a so-called "*antiperistaltic*" anastomosis. All anastomoses were made posterior to the transverse colon.

The series of diagrams in figure 1 portray in a, b and c the extent of resection and the method of gastrojejunostomy. I believe it is worth while to buttress the efferent limb of jejunum medialward along the closure of the gastric pouch for 3 or 4 centimeters. This step not only protects the "*critical angle*" of the anastomosis, but probably more important, diminishes the acute angle of the jejunum between the afferent and efferent limbs. Gastrojejunostomy without this step is illustrated in "d" and it seems apparent that edema about an anastomosis thus created could produce obstruction more readily than could edema in the situation illustrated in "c" (fig. 1).

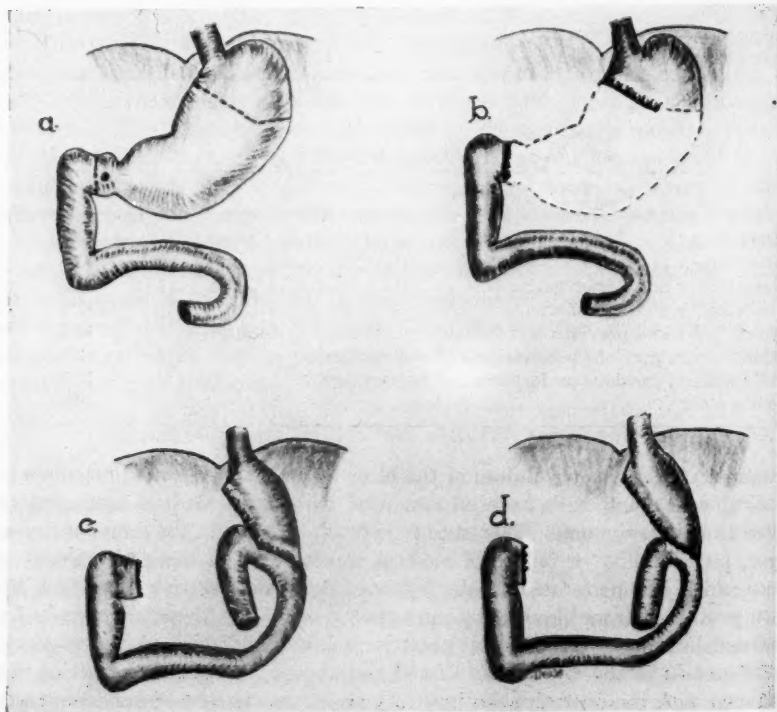


FIG. 1. a, b, and c, show schematically the extent of the resection and the type of gastrojejunostomy referred to in this article. The efferent jejunal limb is sutured past the anastomosis to the closed gastric stump in order not to make too acute an angle between the afferent and efferent limbs. d, shows a potentially acute angle between the two limbs—a situation which probably should be avoided.

COMPLICATIONS

The Duodenal Stump: One patient (A. L.) may have had leakage from the duodenal stump. He left the hospital on the tenth day, but returned a week later with fever and a right upper quadrant mass. The fever and the mass disappeared with antibiotic therapy and the patient was not re-explored. He has remained well (5 years). No other known or suspected duodenal stump complications occurred in this series.

The Anastomosis: Three (7.3 per cent) of the 44 patients had some degree of obstruction of the efferent limb of the anastomosis in the immediate postoperative period. Forty-one (92.7 per cent) were started on oral feedings at 72 hours and thereafter showed no evidence of obstruction. One patient, (R. O.), bled from the suture line for 24 hours postoperatively. He vomited bile when the Levine tube was removed at 72 hours, and the tube was reinserted. Copious bile returned for the next 12 days. The patient was re-explored on the twelfth postoperative day and a hematoma in the gastric stump was found at the anastomosis. A feeding jejunostomy was done. The anastomosis opened the day following re-exploration and the patient was promptly started on oral feedings. A second patient (O.B.) was obstructed for 7 days postoperatively and a third (J.C.) was obstructed 4 days following operation. The last 2 responded to Levine tube suction and had no more obstruction after oral feedings were started.

Postoperative Deaths: There was no immediate mortality in this series. One patient (W.C.) died 4 years postresection of a cerebro-vascular accident. Another (J.W.) died 2 years following operation of a primary bronchiogenic carcinoma. The remaining patients are alive at the time of this writing.

Marginal Ulcer: One proved marginal ulcer developed (M.S.) 3 years postoperatively. This patient was re-resected and at the present time (2 years after re-resection) she has remained free of known marginal ulceration. This patient is to be reported in a separate communication. A second patient (A.L.) had vomiting of blood 2 years following gastric resection. Marginal ulceration could not be demonstrated by roentgenogram or gastroscopy. Since the patient consumed large quantities of alcohol, a diagnosis of alcoholic gastritis was enter-

TABLE IV
Postoperative complications
Early

Complication	Number	Deaths
Obstruction at anastomosis.....	3 (7%)	0
Subhepatic abscess (leaking duodenal stump?).....	1 (2%)	0
Wound dehiscence.....	2 (5%)	0
Thrombophlebitis.....	1 (2%)	0
Nonfatal pulmonary embolus*.....	1 (2%)	0
Hemorrhage from anastomosis†.....	1 (2%)	0

* Same patient that had thrombophlebitis (D. W.).

† One of the patients recorded under obstruction at anastomosis (R. O.).

TABLE V
Postoperative complications
Late

Complication	Number	Deaths
Marginal ulcer*	1	0
Cerebrovascular accident	1	1
Bronchiogenic carcinoma	1	1
Ventral hernia	1	0

* This patient (M. S.) was re-resected 3 years after the initial procedure for marginal ulcer. Another patient (C. H.) was re-explored 1 year postoperatively with a presumptive diagnosis of marginal ulcer and none was found. A third (A. L.) had upper gastrointestinal hemorrhage 2 years postoperatively. Roentgenogram and gastroscopy failed to reveal an ulcer, and since he had been drinking to excess, his diagnosis was considered to be alcoholic gastritis. He has remained well (3 years).

tained. A third patient (C. H.) was explored for marginal ulcer by another surgeon one year postresection. None was found and the anastomosis was left unchanged. No other patient in this series has had known or suspected gastrojejunal ulcer.

RESULTS

In an effort to evaluate the results of this operation 1 to 5 years afterward, the patients were divided into 5 groups according to the descriptive terms Poor, Fair, Good, Good-excellent, and Excellent as follows:

Poor—Constant discomfort after eating, frequent vomiting, marked or maintained weight loss, frequent pain, marginal ulceration with or without bleeding, significant loss of productivity, and marked dissatisfaction. If any one of these criteria were present, the patient was placed in this group.

Fair—Frequent discomfort after eating, occasional vomiting, loss of not more than 20 per cent off best weight, occasional pain, but no marginal ulceration, no significant loss of productivity, and no great dissatisfaction.

Good—Occasional discomfort after eating, loss of not more than 15 per cent off best weight, no pain and well satisfied with procedure.

Good-excellent—Infrequent postprandial discomfort even with overloading of gastric pouch, weight loss of not more than 10 per cent off best weight, no pain, and happy with result.

Excellent—No postprandial discomfort, weight loss of not more than 5 per cent off best weight, enthusiastic about result.

The results of the Billroth II procedure in this series are represented in table VI according to the preceding descriptive terms. Inspecting the table, it would seem that men statistically are more likely to have a good result than are women. A good to excellent result has been obtained in 81 per cent of the procedures, and a poor to fair result in 19 per cent. Every effort has been made to make the evaluation accurate. One patient may describe his postoperative symptoms less well than another, but these patients have been repeatedly seen and examined

TABLE VI

*Results according to descriptive terms—all cases**

	Poor	Fair	Good	Good Excellent	Excellent	Total
Male.....	1	2	7	12	5	27
Female.....	2	2	5	0	0	9
Total.....	3(8%)	4(11%)	12(32%)	12(32%)	5(15%)	36(100%)

* Eight patients of this series are not recorded in this table, as only a year has elapsed since the operative procedure and it may be too early to judge the result.

TABLE VII

Results according to location—duodenal ulcer only

Position of Ulcer	Poor	Fair	Good	Good Excellent	Excellent	Total
Anterior.....	3	1	6	7	3	20
Posterior.....	0	2	4	4	2	12
Total.....	3(9%)	3(9%)	10(32%)	11(35%)	5(15%)	32(100%)

TABLE VIII

Results correlated with average postoperative weight loss

	Poor	Fair	Good	Good Excellent	Excellent
Per cent off best weight	-24%	-16%	-9%	-7%	-5%

personally, and the table represents my opinion of the postoperative situation now.

For comparison, the results in duodenal ulcer only are presented in table VII. A glance is sufficient to point out that there is no great statistical difference between these totals and the totals of the entire series. The patients with duodenal ulcer are further separated by anatomic location, and it may be significant that no patient operated upon for a posterior penetrating duodenal ulcer had a poor result.

Only 2 patients of the series have, at the present time, gained weight in excess of their best preoperative weight. The best average preoperative weight is considered in this study to be the patients normal healthy weight before symptoms became severe enough to necessitate surgical intervention. The immediate preoperative weight was in some cases quite different from the best weight, and although a number of patients gained to, or exceeded, their immediate preoperative weight, the whole group is currently an average of 10 per cent off their best weight. In table VIII the average weight loss according to the previously used descriptive terms is presented merely to point out the apparent fact that, in general, the more the postoperative weight loss, the poorer is the over-all result.

DISCUSSION

The term "*dumping*" has been thus far avoided, as it is variously interpreted. Harkins⁷ reports that of his ulcer patients treated by partial gastrectomy, 24 per cent with Billroth I and 44 per cent with Billroth II anastomoses "*dump*". This seems to imply that 56 per cent of the Billroth II patients have no post-prandial discomfort. In my series this is not true. In fact, only 15 per cent (the excellent group) admit to no distress after meals under any circumstances. When, however, the patients of this series avoid overloading the gastric remnant and avoid excessive sweets, 81 per cent (the good, good-excellent, and excellent groups) have little or no discomfort after meals. Thus, with reasonable deference to dietary habits the unpleasant symptoms of nausea, flushing, and palpitation often described as "*dumping*" are present in varying degree in 19 per cent of this series.

In the immediate postoperative period "*easy filling*" and frequent distress with overloading the gastric remnant is common. This symptom improves however, and poll of the patients reveals that average maximum improvement occurs at about 4 months. In some, improvement begins before the first month, in a few it may take a year. The important fact is that they all improve.

One of the serious disadvantages of the Billroth II type procedure is the fact that the entire duodenum and first few centimeters of jejunum are short circuited. Abundant mucosal folds in the duodenum and upper jejunum with great absorptive capacity are thereby eliminated from the digestive and absorptive process. In addition, duodenal hormonal stimulus to production of biliary and pancreatic enzymes in response to food passing through the duodenum is reduced. Thus, fat and protein splitting enzymes in less than normal amounts first contact ingested food at or distal to the anastomosis. It may be that the upper jejunum never entirely takes over all the function of the short circuited duodenum.

Everson⁸ studied protein and fat assimilation in dogs after the Billroth I and II procedures by determining protein and fat in the stools after ingestion of known amounts of these foods. The results reprinted from Everson are shown in table IX. It is apparent experimentally, at least, that significant amounts of fat and protein are lost in the stool after either variety of gastric resection. More fat and protein is lost after the Billroth II procedure than after the Billroth I.

Ellison² stated that fat absorption is defective if less than 90 per cent is absorbed. In his series, 75 per cent gastric resections with a Billroth II type gastrojejunostomy averaged 71 per cent absorptive efficiency. In contrast, his hemigastrectomy-vagotomy Billroth I patients showed 79 per cent absorptive

TABLE IX
Fat and protein loss (dogs) in stool—Everson.

Procedure	Per cent Protein Lost	Per cent Fat Lost
Normal.....	14.9%	4.9%
Billroth I.....	19.3%	10.6%
Billroth II.....	24.4%	27.7%

efficiency. Although not strictly comparable to this series, his patients with the latter operation showed better postoperative weight gain than those with the Billroth II type procedure. Ellison also believes that the duodenum is an important organ for absorbing fat and protein.

In spite of the logical appeal, and the current popular trend toward the Billroth I operation, there are certain instances where, in my opinion, this procedure is not only technically difficult, but actually hazardous. Particularly is this true in the broad chested, obese individual possessing a posterior duodenal ulcer which has penetrated into the pancreas. Here sufficient mobilization of the duodenum is difficult, and the temptation to compromise the extent of the resection is great. Further, the gastroduodenostomy must be made over or near the inflamed area of the pancreas where the ulcer was removed. In this situation it seems wiser to me to do the Billroth II gastrojejunostomy.

Actually, only 8 per cent of the results with the Billroth II type anastomosis are really poor. The incidence of postoperative obstruction at the efferent limb is low (7.3 per cent) and technically the anastomosis is easy to make after what is currently considered an adequate resection. Tucked away beneath the transverse colon with a small stoma and a comfortable distance separating the afferent jejunal limbs of the anastomosis, the Billroth II procedure is still a safe and effective method of re-establishing the continuity of the gastrointestinal tract after gastric resection. Although I believe the Billroth I procedure will continue to gain favor, no surgeon need apologize for doing the Billroth II type anastomosis in any situation where in his clinical judgment gastroduodenostomy would be the least bit hazardous.

SUMMARY

The cases of 44 patients subjected to $\frac{2}{3}$ to $\frac{3}{4}$ gastric resection with Billroth II type gastrojejunostomy for peptic ulcer are reviewed. Eighty per cent of the patients are males. The anastomoses were all retrocolic, and all but one of the ulcers were removed with the specimen. One to 5 years postoperatively there are 19 per cent poor to fair results and 81 per cent good to excellent. The group averaged 10 per cent weight loss off their best average weight. Generally the patients with the poorest results suffered the most weight loss. Although the Billroth I procedure seems physiologically to be a sounder operation, it is believed that the over-all results of the Billroth II procedure are good, and that it should be used when the former would be difficult or hazardous.

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DISCUSSION

As regards the choice of whether one uses a Billroth I or a Billroth II type of gastric resection, I believe very definitely that a Billroth I should not be employed in the treatment of duodenal ulcer. The duodenum, in these instances, has already demonstrated its inadequacy. When operating, because of a gastric ulcer requiring removal of the prepyloric antrum, I would favor and use quite regularly the Billroth I procedure. When the operation is directed towards cure of carcinoma, then I believe that anything less than total gastrectomy will more and more become the exception, except when the lesion is in the prepyloric antrum. In this location the drainage is such that extension to the contiguous tissues is early and total gastrectomy will not likely add anything beneficial.

I do not favor a massive gastric resection (more than 50 per cent of the stomach) as the primary procedure for the surgical treatment of duodenal ulcer, because of the possibility of obtaining an irretrievable gastric cripple.

May I discuss one of the complications of gastric surgery—"Dumping?"

Henry Randall and his coworkers have shown that reduction of the circulating blood volume by shift of fluids into the bowel to dilute low molecular materials to isotonic concentrations resulting in a temporary shock-like state. I have instituted the following regimen to prevent the fluid shift and development of the phenomenon of "Dumping." It has been my experience to find that individuals who "Dump" have restricted their fluid intake rather drastically. Therefore, a regimen of forcing fluids (4000 cc. daily) is instituted with 500 cc. being taken 10 to 15 minutes before meals. When tolerated, beer is excellent for this purpose. It has a low salt content, stimulates the appetite and adds considerably to the caloric intake. Carbohydrates are the worse offenders in this condition because they are split rapidly by the digestive ferments to low molecular weight glucose. An individual will eat much better if carbohydrates are included in the diet. They can be included if they are rendered slowly digestible, and they can be made slowly digestible if impregnated with fats. The water soluble ferments cannot penetrate the fat barrier and so the carbohydrates will become available for digestion only as the fats are emulsified and digested away. The results have been most gratifying.

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THE FROZEN SHOULDER: CASE ANALYSES WITH REFERENCE TO TREATMENT

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By far the most common shoulder complaint is the inability to abduct or rotate the arm. McLaughlin and others^{1, 2, 3, 4, 5, 6} have demonstrated that most patients with this symptom complex have had an injury to that anatomic entity which has become known as the "*rotator cuff*".

Possibly because of the complicated nature of the shoulder, lack of interest or more likely, the seeming triviality of the condition to everyone but the patient, these symptoms have been rather haphazardly managed under such diagnoses as arthritis, peri arthritis, calcific tendinitis, bursitis or just sprain. Strangely enough all these terms are descriptive of part of a sequence which follows varying degrees of injury to the rotator cuff, some of them eventually leading to soft tissue ankylosis of the shoulder⁷—the "*frozen shoulder*". I will limit my discussion to this sequence.

From figure 1 it can be seen that an upward thrust of the humerus would forcibly jam the tendinous cuff, more especially of the supraspinatus part of it, against the acromial process. This would create a contusion. Likewise, a sudden contraction of the supraspinatus muscle could tear the tendinous fibers in any degree from a slight sprain to a complete rupture. Fortunately most injuries are sprains. Without going into detail, I think it can be understood that continuing efforts of the tendon to heal, modified by the repeated trauma of usage, could result in calcification of tissue debris or walling off of degenerative material to form a sterile abscess. Rupture of such an abscess into the overlying bursa could set up a bursitis from the irritation. Some of them would develop adhesions of the bursal surfaces, soft tissue ankylosis of the shoulder, atrophy of the shoulder muscles, osteoporosis of bone from the disuse and—the "*frozen shoulder*".

Some of these changes, but by no means all, show by roentgenogram. In order to simplify roentgenologic evaluation, I have rather inaccurately used the term "*Increased density*" to cover most every change except calcareous deposits and osteoporosis.

Obviously complete rupture of the cuff, which is rare, should have immediate surgical repair; but the lesser injuries present different problems. I will attempt to show results of more or less haphazard treatment of cases diagnosed as rotator cuff injuries with the hope that a policy of treatment can be formulated.

Figure 2 shows cases treated by diathermy, exercises (wall crawling and pendulum), bed position (arm in abduction on pillow lying on abdomen with head on pillow and arm embracing pillow) and aspirin. Note that anything over a week's duration took months to clear up. I used 90 per cent function as an

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arbitrary standard because 90 per cent is pretty good and 100 per cent is not always obtainable.

Going back to the charts, in figure 3 the pain was so severe that a body-arm abduction cast was applied. These were acute cases. Pain was promptly relieved and most of these patients recovered in 3 to 6 weeks.

Figure 4 shows an odd lot. Four were "frozen shoulders". Adhesions of the bursa were broken up by manipulations. These adhesions will reform unless motion is maintained, especially active motion to bring back the tone of atrophied

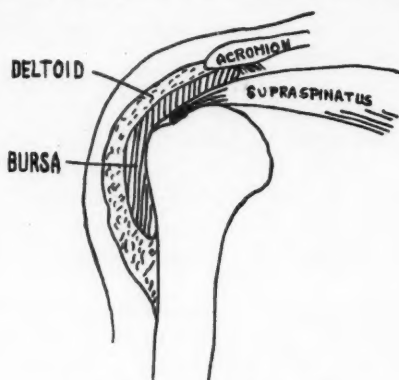


FIG. 1. Relationships in shoulder

Sex	Age	Time	X-ray	90% Use w/o Pain
F	24	1 wk	Negative	3 wk
F	24	4 da	Negative	2 wk
				(re-injury)
M	41	1 da	Negative	19 da
M	61	3 mo	Incr. density	3 wk
F	60	3 mo	Incr. density	14 wk
F	67	6 mo	Negative	6 mo
Avg.	46	8 wk		5 wk

FIG. 2. Physiotherapy only

Sex	Age	Time	X-ray	90% Use w/o Pain
M	43	1 da	Negative	30 da
M	43	4 da	Negative	6 wk
				(re-injury)
F	49	1 wk	Negative	6 wk
M	51	2 da	Negative	24 da
F	56	20 da	Incr. density	3 mo
Avg.	48	7 da		6 wk

FIG. 3. Cast for pain only—acute

Sex	Age	Time	X-ray	90% Use w/o Pain
Manipulation and cast				
*F	59	1 yr	Osteoporosis Incr. density	12 mo
F	50	5 mo	Osteoporosis	3 wk
Manipulation and no cast				
F	50	6 wk	Negative	4 mo
Excise calcareous deposit				
M	45	6 mo	Incr. density	6 wk
Irrigation, Calcareous Deposit				
M	45	6 mo	Large deposit	6 wk

* Wouldn't exercise after cast off

FIG. 4

Sex	Age	Time	X-ray	90% Use w/o Pain
M	79	3 mo	Osteoporosis Incr. density	Quit treatment
M	64	4 mo	Incr. density	Quit treatment 2 wk
*F	80	4 mo	Osteoporosis Incr. density	No improvement 2 mo
*F	60	3 mo	Incr. density	No improvement 3 wk
*F	58	6 wk	Osteoporosis Incr. density	No improvement 5 wk
*F	69	6 mo	Osteoporosis Incr. density	No improvement 10 wk

* Surgery after no improvement.

FIG. 5. Physiotherapy only

Sex	Age	Time	X-ray	90% Use w/o Pain
*F	80	4 mo	Osteoporosis	5 wk
F	61	1 yr	Calc. deposit	4 mo
*F	60	3 mo	Incr. density	2 mo
*F	58	6 wk	Osteoporosis Incr. density	3 mo
*F	69	6 mo	Osteoporosis Incr. density	4 mo
Avg.	66	26 wk		3 mo

FIG. 6. Surgery and cast after other treatments failed



FIG. 6A. Arm-body abduction cast

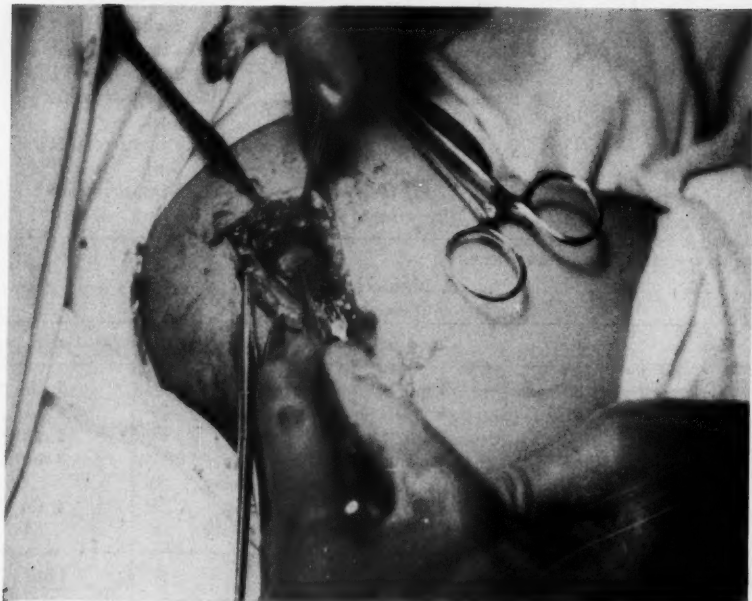


FIG. 7. Calcareous deposit in supraspinatus

muscles by systematic exercise. *The fourth case* shows a common situation in which the patient can be given dramatic relief following aspiration-irrigation of a toothpaste-like material. This is not a true "frozen shoulder".

Figure 5 shows a true "frozen shoulder" group which in spite of exercise, diathermy, injection of hydrocortisone and procaine failed to get improvement. Two of them quit treatment and went to other doctors because I wasn't smart enough to explore their shoulders when the treatment was not helping them.

Figure 6 shows the way I think persistent "frozen shoulder" should be handled. Surgery consisted of exploration of the rotator cuff and curetting out, debriding or excising necrotic, calcareous or proliferative material. The shoulder was then manipulated to break up remaining adhesions of the bursae and an arm-body abduction cast applied. (Fig. 6A) Note that the time spent to obtain good function was not much greater than the time spent on physiotherapy without improvement (Fig. 6).

Figure 7 shows a typical calcareous deposit at surgery.

Figure 8 shows the way casts are cut. As soon as it is dry the top half of the arm portion is removed so that exercise above the horizontal level can be started. The cut along the back of the arm portion is made low so that the patient can do backward flexion of the arm without interference. The same principles apply when manipulation alone is used. After 2 or 3 days the pain from manipulation or surgery is not bad and the patient usually leaves the hospital on the third or



FIG. 8. Arm cast with top removed permits exercise

fourth day. Diathermy in the office is given twice a week. This gives an opportunity to teach, check up on and emphasize exercise. When the cast is removed it is split up the side of the good shoulder and edged with tape so that it can be reapplied.

It is surprising what a person will do with one of these casts on. Women can do the dishes after a week or 2, clean the house, run a typewriter and dress themselves. Men can drive a car, do office work, and supervise a job. I have even seen some carpenter work done while wearing a cast. Marital efforts need not be inhibited.

All of these activities contribute to good result. In effect, the cast forces rehabilitation of the shoulder. As obvious as it seems, I had to learn the hard way not to take off the cast too soon. The cast should not be removed until the muscles have regained most of their tone. When this has been obtained, the pivotal position, external rotation, some internal rotation and forward and backward flexion have already been accomplished. It usually takes 4 to 6 weeks. After the cast is removed abduction and more internal rotation follow almost automatically.

SUMMARY

I have attempted to show the usefulness of the arm-body abduction cast in the lesser acute shoulder cuff injuries and following manipulation or surgical treatment of shoulders having soft tissue ankylosis. If interest in such shoulder conditions is thereby increased, better treatment will surely follow and many suffering people will be grateful.

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DISCUSSION

The term "frozen shoulder" indicates the status of shoulder motion resulting from some underlying lesion without in any way emphasizing the underlying pathology. Doctor Lee has indicated that injury to the rotator cuff is the cause of most frozen shoulders; McLaughlin in a recent article indicated that less than one-half are associated with cuff lesions—DePalma's studies follow these quite closely. An analysis of 67 patients who have been examined and treated by me reveals that only 22 had any evidence of a rotator cuff lesion and in only 4 of these could one find any evidence of a cuff tear (chart I). There was a relatively

large number (24) of patients with trauma other than rotator cuff injuries. Some of these may have sustained minor rotator cuff tears, but they were not severe enough to cause any disability following subsidence of the other injuries about the shoulder. Fortunately, most lesions leading to the end result of frozen shoulder are self limited and will show marked improvement without any treatment.

The one factor that causes stiffness in the shoulder is pain. It causes the patient to protect the arm against the body. This static condition results in slowing the blood flow which in turn leads to venous and lymphatic stasis. An inflammatory process follows that may involve all the tissues of the shoulder. Unless this process is prevented or cleared up in a relatively short time it will result in a frozen shoulder regardless of the underlying cause.

The frozen shoulder can be prevented by never allowing it to remain at complete rest. First, however, the cause of the pain must be found and removed, because the patient will not move and use the shoulder as long as this pain is present in any degree of intensity. On the other hand, once the pain has disappeared, mobilization of the shoulder presents few problems. In fact, most patients will then mobilize the shoulder themselves. As the illustration will show, we have found that a large number of patients with painful shoulders subsequently develop a tenosynovitis of the tendon of the long head of the biceps as it passes through the bicipital groove and in these patients it is necessary to clear up the condition before the shoulder can be mobilized.

In the treatment of the painful and frozen shoulder we have found it necessary to operate on only 6 patients. All of these operations were performed for suspected tear of the rotator cuff. We were able to relieve the pain in all other patients by

CHART I
Analysis of 67 cases

Diagnosis	No. of Cases	Status of Shoulder Motion		
		Normal	Partially stiff	Frozen
Rotator cuff lesions—22				
Ruptures	4		2	2
Calcareous tendinitis	14	5	6	3
Noncalcareous tendinitis	4	1	2	1
Trauma (Other than cuff)	24	1	7	16
Neurogenic—11				
Lesions cervical spine	9		2	7
Cardiac disease	2			2
Primary self limited inflammatory process	10		7	3
Total	67	7	26	34
Secondary tenosynovitis longhead of biceps	31	3	7	34

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conservative treatment, in a short time. This consisted of aspiration of the acute calcareous tendinitis followed by injection of hydrocortisone locally, and x-ray therapy. The other lesions were treated locally by injection of hydrocortisone into the tender areas. I should like to stress that the injection must be made directly into the tender area about the shoulder and not into the shoulder joint alone. In every case, this treatment was supplemented by physical therapy. All showed marked improvement within a short time. Approximately 90 per cent were completely relieved of pain within a few days, and the motion was restored within a month. These patients were able to carry on their regular duties as the pain subsided.

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AFFERENT LOOP VOLVULUS: A SERIOUS COMPLICATION OF SUBTOTAL GASTRECTOMY

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JOEL W. WILLIAMSON, M.D.

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Afferent loop obstruction, a dangerous complication of the Billroth II Gastrectomy, must be relieved immediately, or result almost inevitably in fatal outcome. Unfortunately, its true identity is rarely recognized before onset of overwhelming peritonitis, or irreparable damage to a completely closed bowel segment, into which has poured large quantities of biliary and pancreatic secretion.

Quinn and Gifford,³ in 1950, reported 5 instances of proximal loop obstruction occurring after subtotal gastric resection with antecolic anastomosis. West⁶ later reported 3 and cited another. He pointed out characteristic features of this type of obstruction, which were (1) constant pain, (2) vomitus which did not contain bile, (3) a roentgen shadow in the left upper abdomen due to pressure of fluid in the distended loop, (4) a mass which was palpable in thin patients, (5) perforation of the obstructed loop with the development of peritonitis. Perry,² in 1953, reported this complication in a patient whose clinical picture, including laboratory findings, was identical with acute pancreatitis. This similarity again was noted in a case described by Thal and Perry.⁵ Recently Simon⁴ added 2 to this group, and discussed their mechanism and prevention.

Antecolic gastrojejunostomy had been accomplished in each instance, with attachment of a long, afferent jejunal loop to the lesser curvature of the stomach. Obstruction had resulted from torsion of the long loop at the gastrojejunal anastomosis and obviously could have occurred anytime after the initial procedure.

The present case, which happened under somewhat different circumstances, serves to both point out the pitfalls of early diagnosis and emphasize the need for employment of every means available to avoid such an occurrence.

A 35 year old Negro man was operated upon on Aug. 5, 1955, because of a duodenal ulcer which perforated in 1950 and recently had been the source of 2 severe hemorrhages. An antecolic, Hoffmeister subtotal gastrectomy was accomplished without difficulty, easily closing the duodenum below the site of ulceration and accomplishing a satisfactory gastrojejunostomy with the afferent loop attached to the border of the lesser curvature of the stomach.

Postoperative recovery being uneventful, the patient received instruction as to proper care and diet, and was discharged on the seventeenth postoperative day. He returned for follow-up examination on October 4, stating that he had returned to work, was feeling well, eating regularly without difficulty, and had no abdominal complaint. Barium study revealed a subtotal gastrectomy with well functioning stoma. Angulation at the anastomosis and failure of contrast

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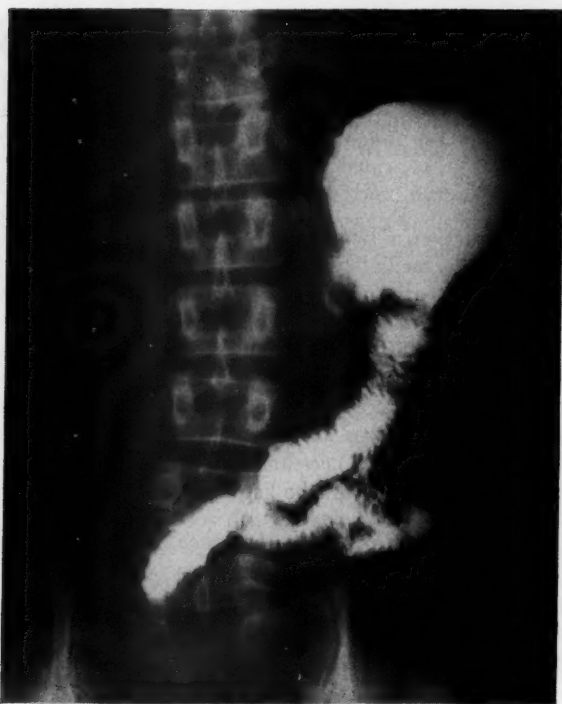


FIG. 1. Postoperative barium study showing angulation, with failure of contrast material to enter the afferent loop.

material to enter the afferent loop, unfortunately were thought to be of little significance.

He was readmitted the morning of Jan. 12, 1956, stating that he felt very well until the night before, when he became uncomfortable after eating a large meal consisting of spinach and rice. Sudden epigastric pain, nausea, and vomiting started shortly after midnight and had required administration of a narcotic for relief. He had vomited large quantities of paste-like, undigested food and now was considerably relieved.

Examination at 6:00 a.m. revealed a slender, Negro man, lying in bed, apparently not acutely ill. His blood pressure was 124/78, pulse 84, respiration 16 per minute. His abdomen was flat and revealed only the well healed scars of previous operations. Generalized moderate epigastric tenderness with some muscle guarding was elicited by palpation. There were no palpable masses. Auscultation disclosed normal borborygmi.

The Laboratory reported a total count of 10,000 white cells per cubic millimeter of blood with differential of 74 neutrophils, 4 stabs, 16 lymphocytes, 3 monocytes, and 3 eosinophils. No abnormalities were noted in the red cell count, hemoglobin, serology, or urinalysis. Abdominal roentgenograms failed to show

the presence of free air under the diaphragm, fluid levels suggesting intestinal obstruction, or evidence of an abdominal mass.

The patient, who now declared that he was hungry, had obviously considerably overdistended his small gastric pouch and, since there had been adequate regurgitation of the offending material, lack of roentgenologic evidence of perforation or intestinal obstruction, and relief since onset of symptoms, a period of further observation was decided upon. He was comfortable throughout the morning and received 1000 cc. 5 per cent glucose in normal saline by clysis. At noon he was able to take and tolerate a small amount of liquid.

Abdominal pain, involving the entire abdomen, returned early in the afternoon and rapidly became worse. He now had developed an obviously overwhelming peritonitis which failed to respond to supportive therapy. He later died.

Postmortem Examination: The abdominal cavity was filled with a large amount of bile colored fluid containing flakes of fibrin, but no evidence of food. Release of this material had resulted in diffuse overwhelming peritonitis. The site of perforation was not immediately apparent, and there was no evidence of strangulation or obstruction of the bowel. The now almost empty stomach showed evidence of recent marked distention, and there was considerable dilatation of the jejunum at the site of gastrojejunostomy and in the upper efferent loop. The line of anastomosis was well healed, and there remained a satisfactory patent stoma of the usual Hoffmeister type. The afferent loop, between the ligament of Treitz and site of anastomosis, was of proper length without evidence of strangulation or adhesions. Just proximal to the gastrointestinal anastomosis, however, the bowel, although presently patent, folded upon itself, and it became apparent that packing of the gastric pouch and anastomotic site with bulky food had caused a volvulus with temporary complete obstruction. This impression was confirmed upon opening the bowel, by the presence of bile stained intestinal juice proximal to the fold and complete absence of bile in the remaining pasty

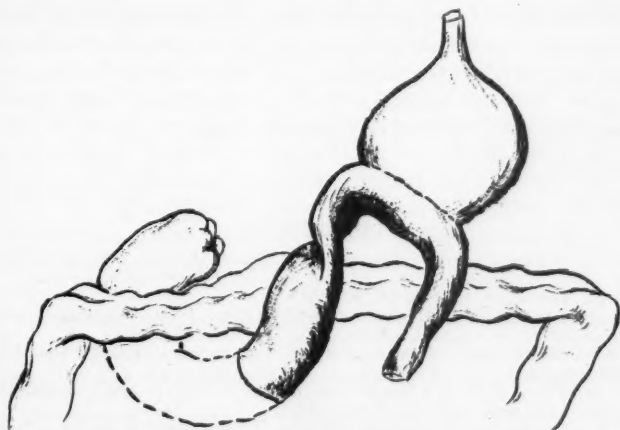


Fig. 2. Volvulus causing obstruction, with distention of the afferent loop.

material contained in the gastric pouch and jejunum. Intrinsic pressure from rapid outpouring of bile and pancreatic juice into the completely closed short segment of duodenum and upper jejunum had caused a blow-out in the scar from closure of the duodenal stump. Since the stump had been carefully covered, the site of perforation was only discovered after removal and examination of the entire specimen.

Comment: This patient, 5 months after uneventful recovery from subtotal gastrectomy without residual discomfort of any sort, engorged his small gastric pouch and jejunal anastomotic segment with a large quantity of bulky food. The distention thus produced, caused a volvulus of the afferent loop just proximal to the anastomosis, with temporary complete obstruction. Rapid pouring of biliary and pancreatic secretion into the short, completely closed bowel segment produced increasing pressure with development of acute pain and later, rupture of the duodenal stump.

When first examined, the patient, having recently disengorged the offending material from his stomach, was now comfortable. Since the obstructed afferent loop had contained no gas and was now emptied of digestive juices, there was no localized tenderness, no palpable mass, and no roentgenologic evidence of air under the diaphragm or fluid level suggesting obstruction. The ordinary findings of acute abdominal disease were now entirely absent and did not return until the unmistakable onset of peritonitis.

SUMMARY

Afferent loop volvulus must be relieved by early operation and decompression. This extremely serious complication should be immediately recognized by absence of bile in the gastric pouch of a post Billroth II gastrectomy patient who has suddenly developed severe upper abdominal, colicky pain.

Attention is directed to the following quotation from Payne's¹ excellent editorial:

"After the resection of the desired amount of stomach and after the duodenal stump has been closed, it is my custom to return the gastric remnant to its future and normal position under the diaphragm and then pick up the jejunum, adjust it to fit loosely without angulation to the stomach, and mark this area, for anastomosis, with cotton thread or Babcock forceps."

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ACUTE ENTEROCOLITIS

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This report presents 7 cases of acute enterocolitis, also called acute staphylococcal or pseudomembranous enterocolitis. Careful study of this small number of patients has helped clarify some of the puzzling aspects of the syndrome, but also has revealed some facts which tend to confuse this interesting but unsolved problem. Of greater importance, perhaps, has been the formulation of a regimen for handling such patients.

We prefer the term acute enterocolitis to pseudomembranous or staphylococcal enterocolitis because neither the pseudomembrane nor the staphylococcus invariably is present. Further, the clinical picture varies so that accurate definition of terms is difficult. Our patients showed gradations in severity, ranging from mild diarrhea to an acute fulminating disease with high fever and peripheral vascular collapse. The only features common to all were diarrhea and green stools with whitish flocculations. The white flocculent material is always found on microscopic examination to be a purulent exudate.

Enterocolitis has been described in textbooks for over 50 years. In 1893, Finney⁸ reported fatal diphtheritic enterocolitis following surgery. Bockus¹ stated the colon bacillus and the staphylococcus are frequent offenders and called attention to the superficial ulcerations with membranous exudate in the upper rectum and lower sigmoid produced by heavy metals and toxic chemicals. Although enterocolitis was seen and treated before the era of bacteriocidal agents, its frequency has apparently increased since the introduction of antibiotics, particularly those of the so-called broad spectrum varieties²¹. Fairlie and Kendall⁶ describe fatal cases of staphylococcus enteritis following intramuscular penicillin and dihydrostreptomycin therapy, in which both the small intestine and colon yielded pure cultures of staphylococcus aureus (coagulase positive). They admit that the exact role of the staphylococcus in their cases is not clear.

That the antibiotics figure in the etiology of this disease has been often and quite positively stated. Certainly enterocolitis has been reported following the use of most of them. Penicillin and streptomycin are mentioned¹⁰ but the "broad spectrum" antibiotics, aureomycin and terramycin, are most often indicated^{4, 7, 9, 10, 12, 13, 14, 17, 19}. The usual concept is that enterocolitis arises from suppression or alteration of the normal intestinal flora by the antibiotics, thus permitting staphylococci to achieve pathologic proportions.

Wooldridge and Swinton,²⁰ however, believed that such a concept oversimplifies the problem and stressed the historic occurrence of the disease before the advent of antibiotics.

That the antibiotics are not a prerequisite for the development of acute entero-

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colitis is known¹². Dearing and Heilman³ reported 42 deaths due to pseudomembranous enterocolitis in the 10 years prior to 1943, and 37 thereafter. Dawson-Edwards and Morrissey² reported 8 cases following partial gastrectomy in patients none of whom had preoperative antibiotics.

The exact role of the staphylococcus aureus (micrococcus pyogenes) in enterocolitis also has been controversial. Many authors^{4, 6, 7, 9, 10, 13, 18, 19} have reported pure stool cultures of this organism and often it has proved insensitive to all antibiotics except erythromycin. Dearing, Heilman and Sauer,⁴ in studying patients given terramycin preoperatively, found that by the time of surgery some developed pure cultures of micrococcus pyogenes. If untreated, gastrointestinal reactions ensued which could be readily controlled with erythromycin.

Experimental support of the staphylococcus etiology comes from Dukes and Tettenbaum⁵ who concluded from their investigation that tetracycline is capable of potentiating experimental infections of micrococcus pyogenes in white mice.

Evidence against the staphylococcal etiology is reported by Prohaska and associates¹⁶ who treated 3 patients successfully using corticotropin (ACTH) and no antibiotic whatever. The existence of this entity for many years is further suggestive evidence against an increasingly virulent strain of staphylococci in its etiology.

CASE REPORT

Case 1. A. B., a 70 year old white woman, was admitted to the Gynecological Service of the Mercer Hospital on Nov. 6, 1951, for pelvic examination and biopsy of the cervix. Her physical examination revealed a mild hypertension and a slight cardiac enlargement. The following day a repair of the vaginal floor, biopsy and conization of the cervix was performed, and she was given 50 mg. of aureomycin every 6 hours.

Five days later, after receiving 1.5 grams of the drug, she developed diarrhea with many loose mucoid stools. The aureomycin was discontinued and sulfaguanadine, fluids and antispasmodics administered. Stool cultures showed no pathologic organisms. The patient improved and cervical irradiation with 90 mg. of radium was undertaken because the biopsy showed malignancy. Immediately after the radium had been removed the diarrhea recurred. Proctoscopically much mucopurulent discharge was seen in the rectum. The mucosa was reddened, congested and indurated up to the 9 inch level. Re-examination 1 month later showed residual mucosal reddening.

Comment: This patient had no history of previous colon or small bowel disorder. Five days after ingesting comparatively small doses of aureomycin she developed an enterocolitis, which was slowly controlled by discontinuance of the antibiotic, oral sulfaguanadine and supportive measures. Barium enema study 24 days and 54 days after the onset of the diarrhea failed to reveal any disease of the colon.

Case 2. A. C., a 71 year old white woman, was admitted to the Mercer Hospital on July 6, 1952, with a history of having 10 to 11 loose stools per day accompanied by tenesmus. The stools were specked with pus and mucus. Four weeks previously the patient suffered from a urinary tract infection and was given 250 mg. of terramycin every 8 hours. Although the urinary infection subsided, she continued to use the antibiotics until the debilitating diarrhea caused her hospitalization. Her past history was unremarkable.

Physical examination. The abdomen was diffusely tender. The rectal mucosa felt "peb-

bly." Proctoscopic examination showed numerous raised, round, firm white islands of membranous material varying from 2 to 8 mm. in diameter, projecting 2 to 4 mm. into the lumen of the bowel, simulating colonies of bacteria on media plates and occasionally appearing in groups or streaks. When this membrane was removed, bleeding shallow ulcers remained, between which the mucosa was somewhat reddened. The lesions were visualized throughout the lower 20 cm. of rectosigmoid.

Laboratory data. Leukocytes varied from 13,000 to 18,000 per cu. mm., with 79 per cent polymorphonuclears and 3 per cent eosinophils. Urine and blood chlorides, total proteins and A/G ratio, serum sodium and potassium were normal. Agglutination tests for all enteric organisms were negative. The blood sedimentation rate was only 16 mm. per hour. Stool cultures first revealed aerobacter aerogenes and proteus vulgaris, later *E. Coli* and proteus vulgaris.

A biopsy of the rectal lesions was reported as follows: "Specimen consists of minute gelatinous fragments somewhat bile pigmented, the largest measuring 5 by 4 by 3 mm. and having a grayish-white appearance". Microscopically, "fibro-muscular tissues support a somewhat papillary-appearing fragment of normal mucous glands from the colon. These show a marked polymorphonuclear exudate on their surface and display some areas of bile pigmentation. No *Entamoeba histolytica* are visualized on section, nor are there any fungi noticeable on the H. and E. stain. Impression: Purulent colitis". Specific stains for fungi were negative.

Progress note. The patient's temperature remained elevated for 13 days. All antibiotics were discontinued until the sixth day when she received a gram of sulfasuxadine every fourth hour. Administration of intravenous fluids was continued throughout the course of her disease.

When on the fifth day an electrocardiogram suggested an electrolytic imbalance possibly due to potassium insufficiency, oral potassium and Valentine's meat extract were given. Nine days after admission, $\frac{1}{2}$ gram of sulfadiazine was added to the sulfasuxadine every fourth hour. Thereafter her condition seemed to improve; the stools diminished in number and became formed. Repeat sigmoidoscopic examination 8 days after admission revealed fewer and smaller nodules than previously described, and a less inflamed mucosa. Barium enema revealed innumerable radiolucencies throughout the colon. A marked degree of marginal irregularity was noted throughout. Haustral markings and colonic contractability were intact. The patient left the hospital on July 29, 1952, apparently recovered. There was no recurrence.

Comment: This patient developed her ileocolitis after prolonged use of terramycin, 750 mg. per day for over 2 weeks. The first examination revealed colony-like membranous islands in the rectum and sigmoid. By improving her hydration and nutrition and by replacing her electrolytes her condition improved. Sulfasuxadine and sulfadiazine seemed to speed her recovery. *Proteus vulgaris* and *E. Coli* were found on culture. On biopsy, many organisms were visualized but not identified on slides. Her improvement, although complete, was somewhat deferred. Both this case and case 1 are true examples of enterocolitis of a mild to moderately severe nature following the use of antibiotics.

Case 3. V. N., a 26 year old white man was admitted to the Graduate Hospital for the second time on Feb. 9, 1954, for subtotal colectomy and ileostomy. This patient had a 15 month history of chronic ulcerative colitis complicated in recent months by persistent hemorrhage. A previous hospital admission for 11 weeks of conservative treatment in the fall of 1953 resulted in little improvement. A total of 16 liters of blood had been administered during the 5 months prior to this hospitalization. He had received no ACTH or cortisone therapy.

Course in the hospital: After adequate preoperative preparation consisting primarily of

blood transfusions and bowel preparation with neomycin and sulfathalidine, an ileostomy and subtotal colectomy was done on Nov. 1, 1954. At operation, the entire colon was found to be involved in the ulcerative process. The procedure was uneventful.

On the evening of his operative day, the patient was described as "wild" and tugged at his tube, catheter and dressings. His temperature rose to 104 F. A continuation of his maniacal behavior on the following day was accompanied by continuing fever to 105 F. The chest and abdominal examinations were noncontributory. By the third postoperative day there was evidence of excessive ileostomy flow, abdominal distention (in spite of constant suction) and dehydration. Renal output remained adequate at all times notwithstanding the evident dehydration. The stool was green and watery, and on microscopic examination, appeared to represent a purulent exudate. A culture was positive for staphylococcus aureus, resistant to all antibiotics except erythromycin. A total eosinophil count on the sixth postoperative day was 910 per cu. mm.

In spite of the profuse diarrhea, constant aspiration of the gastrointestinal tract was necessary to prevent vomiting and relieve distention. From 6 to 10 liters of intravenous fluid were required daily to replace losses. Urinary output remained adequate.

On the fifth postoperative day erythromycin was started and cortisone (200 mg. per day) was added 24 hours later. The patient's course from this time improved steadily until his discharge from the hospital on the 21st postoperative day. It was only briefly upset by a urinary tract infection which responded promptly to catheter drainage. At the time of discharge the temperature was normal, as was the ileostomy function.

Comment: This patient demonstrates a typical fulminating enterocolitis with fever and shock. The tremendous exchange of fluid and electrolytes during this patient's illness is graphically represented in figures 1 and 2. We were particularly intrigued by the continued excretion of adequate quantities of urine (figure 1) in spite of the obvious clinical evidence of dehydration. The low concentrations of sodium and chloride in the urine (figure 2) indicate that the kidneys were conserving these ions, but not water. The possibility of posterior pituitary dysfunction as a contributing factor must be considered but we have no evidence to substantiate this thought. Not shown in the figures are the serum electrolyte con-

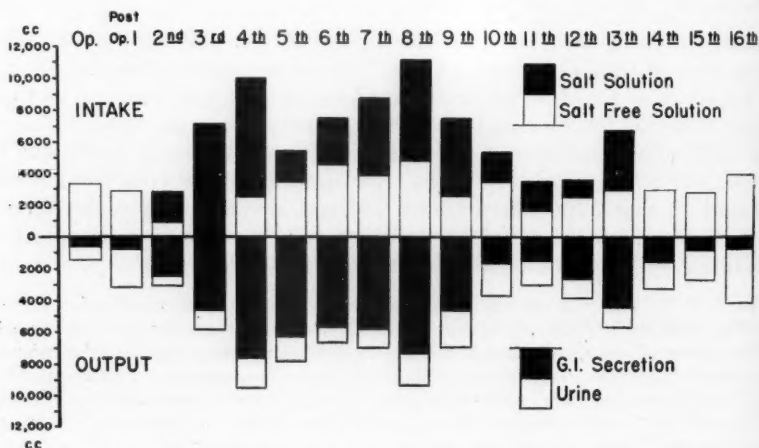


FIG. 1. Table of fluid and electrolyte exchange in case 3

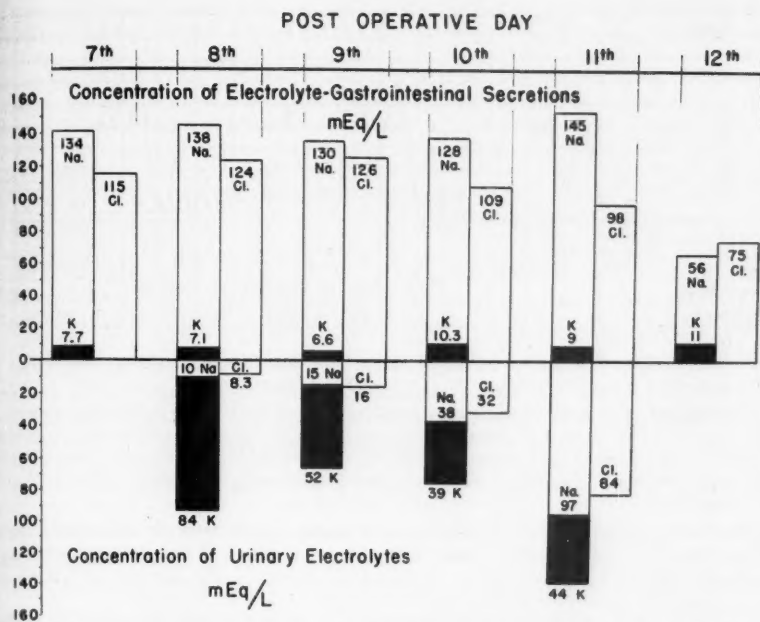


FIG. 2. Concentrations of electrolytes in gastrointestinal secretions and urine of case 3.

centrations which were increased during the early phase of his illness, the sodium reaching a maximum of 158 mEq/L and the chloride 112 mEq/L. This was in part due to the ill-advised administration of hypertonic saline on the second post-operative day and in part to loss of water in excess of salt. In spite of such high serum concentrations, however, the urinary output of these ions remained low. Such findings suggest a deficiency of antidiuretic hormone.

The patient's clinical course and response to treatment is illustrated in figure 3. The apparent response to cortisone therapy could be coincidence since erythromycin was being administered at the same time. In such severe cases we have not withheld either of these drugs and are, therefore, unable to state which is the more efficacious. The progressive improvement in the clinical status of the patient as the eosinophil count decreased is striking in any event. It is perhaps worthy of note that the leukocyte count remained within normal limits until the onset of the urinary tract infection on the twelfth postoperative day.

This case demonstrates a therapeutic program which has proved successful in our patients with acute enterocolitis. In summary, this program includes treatment of the infection with the antibiotic to which the intestinal organism is susceptible; maintaining water and electrolyte integrity by replacement of measured losses and supplementation of adrenal cortical hormone if a deficiency exists.*

* This case has been included in a paper entitled "Post-Operative Care Following Surgical Treatment of Chronic Ulcerative Colitis" by Cooper, Stahlgren and Ferguson, being published in another journal.

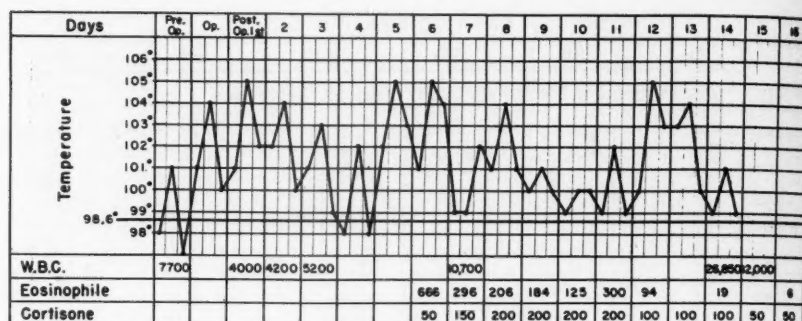


FIG. 3. Clinical course of case 3 and reaction to treatment

Case 4, F. M., a 71 year old white man, was admitted to the Graduate Hospital on Sept. 9, 1953, with a 3-day history of intermittent crampy, midepigastic pain, anorexia, nausea, vomiting and failure to pass gas or to have a bowel movement. He denied all other gastrointestinal symptoms. There had been no weight loss or change in bowel habits during the past year.

Physical examination: Temperature and respirations were normal; the pulse was 108; blood pressure was 135/90. Significant findings were confined to the abdomen which was markedly distended but not tender. There was hyperactive high-pitched peristalsis and borborygmi. No masses were palpated. Rectal examination was negative.

Course in the hospital: Following roentgenologic diagnosis of small bowel obstruction, a Miller-Abbott tube was inserted and because the abdomen became silent, an operation was performed approximately 8 hours following his admission to the hospital. At the time of operation a completely obstructing carcinoma of the sigmoid colon was found with an incompetent ileocecal valve and distention of the entire large and small bowel but no gangrenous areas. Because of the obstruction an exteriorization was carried out, forming a sigmoid colostomy and excising the tumor from the exteriorized loop.

Postoperative course: For the first 2 postoperative days this patient's course was marked by continued abdominal distention and mild paralytic ileus. On the second postoperative day he began to discharge large quantities of intestinal secretions from the Miller-Abbott tube and this collection from the long tube carried on until about 24 hours before death. The total amount of tube drainage varied during these 10 days between 6500 ml. and 1900 ml./day. During the time the tube drainage was cut to 1900 ml./day the colostomy had begun to function and large amounts of intestinal secretion were being lost through this means. Stools per colostomy were not accurately measured. From the fourth postoperative day the urinary output was amazingly high, running between 1800 and 2200 ml. of urine in spite of apparent clinical dehydration. Early in the patient's course the urine contained sodium and chloride concentrations of 65 and 72 mEq/L respectively. Later, however, the concentration of sodium and chloride in the urine was negligible in spite of a large water output. During the first 10 postoperative days the aspirated gastrointestinal secretions were described as being greenish to purulent. The patient was treated with intubation during this time for what was thought to be partial small bowel obstruction because the colostomy excreted only small amounts of fecal material. On the tenth postoperative day the colostomy began to drain with great profusion and continued to drain for the remainder of his hospital stay. The fecal material became purulent, the same as the material aspirated from the Miller-Abbott tube. This was not cultured. By the twelfth postoperative day the patient started a very rapid decline, went into shock and stopped producing urine or intestinal secretion. On the thirteenth postoperative day he died.

Summary of blood work. The patient had a hemoglobin of 15 grams per cent on admission to the hospital and, as dehydration progressed, this rose to 23 grams per cent. Just before death it was 20.8 grams per cent. The patient's white blood count remained normal at all times both in total and in differential counts. The total eosinophil count on the eleventh postoperative day was 3 eosinophils per cu. mm. Blood urea nitrogen remained about 18 to 25 mg. per cent during most of the hospital course, but terminally it was elevated to 45 mg. per cent. The serum potassium was normal at all times. Serum chloride, early in this patient's course, was in the low 80's and finally was elevated to normal about the fourth postoperative day. Toward the end of his hospital stay this rose to 119 mEq/L. The serum sodium followed a similar course, being in the low 120's during the early portion of his stay and about normal from the fourth postoperative day until the day before his death when it was elevated to the unusually high level of 168 mEq/L. These high concentrations of sodium and chloride were not a result of saline infusions.

Comment: We believe that this patient represents an unrecognized occurrence of acute enterocolitis associated with postoperative incomplete small bowel obstruction following resection for obstructing carcinoma of the sigmoid colon. The large loss by the gastrointestinal tract of secretions which were described as green, greenish-brown and purulent is characteristic of the disease. It is noteworthy that this patient received no preoperative antibiotics. As in the preceding case, there was renal conservation of sodium and chloride without conservation of water, in spite of obvious dehydration. Even on the last day of life when the concentration of both the ionic and formed blood elements increased out of all proportion, the urinary output was high. This is our only known death from this entity. We can only speculate as to the outcome had we recognized this disease and treated the patient according to our present concepts.

Case 5. J. H., a 45 year old white man, was admitted to the Graduate Hospital on Feb. 15, 1952. He had a 2½ year history of ulcerative colitis with acute hemorrhage 2 years prior to this admission and slight recent hemorrhage. Roentgenologic examination previously had shown segmental colitis extending from the right colon to the sigmoid colon. Sigmoidoscopic examination of the rectum revealed no mucosal disease. The patient was known to have mild diabetes and prior to his operation had received no hormone therapy.

Course in the hospital: The bowel was prepared with aureomycin and on February 23, a subtotal colectomy with ileosigmoidostomy was carried out. The patient's early postoperative course was unusually smooth. On the fourth postoperative day the patient passed 3 rather large, loose, watery, and brown stools. The Miller-Abbott tube was removed. The diarrhea continued severe enough to cause perianal irritation but the patient did well and was placed on a diet. The diarrhetic stools were not measured. On the sixth postoperative day this patient had a sudden fall in blood pressure which was thought due to acute gastric retention and 1500 ml. of liquid were aspirated from the stomach with some relief. On the following morning he appeared moribund, without pulse or blood pressure. There was no evidence of coronary occlusion, phlebitis, pulmonary embolus or peritonitis. The hemoglobin was found to be 17.4 grams per cent with 6.8 million red blood cells, apparently the result of extreme dehydration. A diagnosis of severe loss of extracellular fluid and electrolytes due to diarrhea was made. A total of 7 liters of intravenous fluid was administered that same day. This consisted of 1 pint of whole blood and the rest of saline. The patient's eosinophil count revealed no eosinophils per cu. mm. of blood, which was believed to rule against adrenal cortical insufficiency. The concentrations of serum electrolytes were normal.

The patient responded well to the large quantities of intravenous saline and on the following day continued to have profuse watery, greenish-brown stools. The abdomen remained somewhat distended and peristalsis was hypoactive. A Thorne test was inconclusive.

The diarrhea continued and on the thirteenth postoperative day he had a complete wound dehiscence with evisceration. This was closed with through and through wires. This patient then improved until the sixteenth postoperative day when his condition again became critical. The stool became frankly hemorrhagic and 3 liters of dark blood were collected. His hemoglobin dropped to 8.8 grams per cent and the red cell count to 2.7 million. The temperature at this time was 104 F., the white blood count 31,000, and absolute eosinophil count 145 per cu. mm. Sigmoidoscopic examination revealed no disease in the rectum but blood was seen coming down from above. He responded well to 2500 cc. of whole blood, 2 liters of saline and 2 liters of 5 per cent glucose and water. The bleeding stopped and from this day on the patient had continuous steady improvement as the stools became formed. It was possible to discharge him from the hospital feeling well on March 25, 1952.

Comment: We cared for this patient before we understood about acute enterocolitis and therefore the stools were not examined under the microscope nor were they cultured. On reviewing his record, we believe that he did have acute enterocolitis which initiated all of his postoperative complications. If this is true, the patient apparently improved without the benefit of adrenal steroids, ACTH, or erythromycin. Because of his difficulties with enterocolitis he experienced further complications with wound healing and also with massive hemorrhage from the bowel. His acute collapse probably occurred because the diarrhetic stool was not measured and recorded and, therefore, not properly replaced with saline. In addition, it was not recognized by the house staff that a patient could be in serious salt and water deficit and retain normal concentrations of serum electrolytes. This patient demonstrates both points.

Case 6. J. K., a 19 year old white girl, was admitted to the Graduate Hospital for ileocolitis on May 12, 1954, her fifth admission in 4 years. She had required incision and drainage of perirectal abscesses on previous occasions and for the past 3½ weeks had been experiencing severe malaise, crampy pains and diarrhea.

Physical examination: This patient appeared acutely ill, pale and dehydrated. The blood pressure was 110/65; temperature 100 F.; pulse 100; respirations 20. No masses, tenderness, ascites or other abnormalities were found in the abdomen. There was a recent sinus tract at the anus where an incision and drainage of an abscess had been carried out.

Course in the hospital: The patient's preoperative medication included no adrenal steroids. She was given sulfathalidine and neomycin and then neomycin and terramycin in preparation for surgery. The operation was performed on May 20, 1954, at which time 2 feet of terminal ileum and cecum just above the ileocecal valve were resected and an ileo-ascending colostomy performed. Following this the distal one-half of the transverse colon, the splenic flexure and 2 to 3 inches of descending colon were resected, and the transverse colon anastomosed to the descending colon. Postoperatively, the patient did well until the second postoperative day, at which time she produced 8 liquid, dark green stools. Because of the possibility of acute enterocolitis, penicillin and streptomycin, begun postoperatively, were discontinued on the second postoperative day and erythromycin started. Microscopic examination of her stools revealed a purulent exudate and solid matter appeared to be pure pus. The stool was cultured and a staph. albus was recovered, but this was resistant to all antibiotics tested, which included aureomycin, chloromycetin, penicillin, streptomycin, terramycin, erythromycin and polymyxin. During the patient's postoperative course she was never a very great problem. The temperature elevation which she had had prior to operation returned to and remained normal. Urinary output was adequate throughout her hospital course and turnover of fluids was never excessive. The serum electrolytes remained practically normal at all times. She was bothered with 5 to 10 bowel movements a day which measured between 800 and 2400 ml. of stool per day.

Laboratory findings: Although the patient was somewhat anemic on admission to the hospital, she was prepared for operation by whole blood and was never anemic again. Her leukocyte count never exceeded 16,800 which occurred 3 days before operation. The patient had absolute eosinophil counts done following her operation, and on her first postoperative day the count was 25/cu. mm. Thorne's test was done on the third postoperative day but was inconclusive.

Comment: We believe this case to be an example of a very mild form of the disease we are discussing plus an example of the difficulties which we have in making this diagnosis. Apparently the requirements for diagnosis were fulfilled by the typical pus, the green stools and culturing of the organism, but the mild to moderate diarrhea could well follow resection of 2 rather major trunks of bowel in a patient with regional enteritis. The organism present was resistant to the erythromycin which probably had no effect on her subsequent course. This type of patient probably is best handled by giving adequate fluid and electrolyte replacement.

Case 7. P. D., a 42 year old patient, was admitted to the Graduate Hospital on July 11, 1954, with a 4 year history of ulcerative colitis involving the transverse and descending colon. He also had multiple anal fistulas with which he had been troubled for 4 years. Medication elsewhere had included streptomycin, penicillin, neomycin, amoebicides, cortisone in questionable amounts, and apparently some other medications of which we do not have an accurate history.

Physical examination. This was a thin, cachetic, emaciated, middle aged white man who appeared chronically ill. The blood pressure was 105/60; temperature 99.8 F.; pulse and respirations normal. The abdomen was scaphoid with moderate muscle guarding throughout and some tympany. No masses or organs were palpated. The anal sphincter was scarred and deformed. The rectal mucosa was markedly roughened, redundant and irregular. Sigmoidoscopic examination revealed a small fistula in ano about 1 inch from the anus and a larger fistula on the right lateral wall. There was no mucosal abnormality in the rectum but the mucosa seemed to be bathed in pus which was coming from above. After thorough study, the patient was prepared for operation by means of multiple blood transfusions and neomycin-terramycin bowel preparation. On July 22, 1954, the hepatic flexure, transverse colon, splenic flexure and portions of the descending colon were removed. An ascending colostomy was fashioned and the stump of the sigmoid closed and dropped back into the abdomen.

Postoperative course: This patient, who had a continually spiking fever to 103 F. preoperatively, exhibited a normal temperature throughout his entire postoperative course. His condition was satisfactory for the first 4 days and on the fourth, the colostomy began to drain large quantities of green, watery, whitish flocculent material. Microscopic examination of this material revealed it to be a very heavy concentration of white blood cells. The stool was sent for culture which revealed a *pseudomonas aeruginosa* resistant to all antibiotics and a *staphylococcus aureus* which was resistant to all antibiotics but erythromycin. The patient was started on liquids on the fourth postoperative day, but for the next several days was very lethargic, weak and refused his feedings. At times he would vomit food. Between the fifth and tenth postoperative days he lost 3 to 5 liters of gastrointestinal secretions per day, these coming both from his colostomy and, by vomiting or intubation, from his upper tract. The absolute eosinophil count was 0. On the eleventh postoperative day the patient was started on cortisone, following which he made a dramatic recovery. The secretions coming from his colostomy cut down abruptly to about 1 liter per day; he stopped vomiting and began to eat a regular house diet. He was given 60 mg. of cortisone followed by 25 mg. 4 times daily. After 2 days of this medication he ate well and 4 days later was discharged from the hospital on diminishing doses of cortisone. The patient

was never acutely ill during this episode of profuse drainage, but was a problem in fluid and electrolyte exchange.

Comment: We believe this patient fulfills the usual criteria for a diagnosis of acute enterocolitis in that he had the typical profuse greenish discharge with white flocculations consisting of clumps of pus. The staphylococcus cultured from this was found to be resistant to all antibiotics except erythromycin. This man's disease was very mild. It is of great interest to us that cortisone apparently invoked dramatic improvement. Erythromycin was ordered for the patient but through a nursing error only a single dose of 500 mg. was administered. We believe that erythromycin had nothing to do with this patient's recovery. It is possible that the cortisone was of greater value in raising the patient's morale and sense of well being than in any organic effect it may have had. This patient probably would have improved with judicious fluid and electrolyte therapy and without cortisone or erythromycin.

DISCUSSION

Clinical features. Acute enterocolitis, often following the use of antibiotics, particularly the wide spectrum variety, is now extensively recognized. Even this small group shows the wide range of possibilities in both the severity and clinical signs of the disease. Diarrhea is the most frequent symptom. This may be mild, moderate or severe with copious, greenish stools containing mucus and floccules of bile-stained pus. Excessive fatigue and exhaustion are common. Fever is usual, varying from 99.4 to 106 F., depending upon the severity of the reaction. Anorexia, nausea, vomiting, abdominal distention and tenesmus often are present. The severer forms of the disease with great systemic reaction may present dehydration and varying grades of shock associated with restlessness and mental confusion.

The severity of the disease does not depend entirely upon the amount or duration of administration of the antibiotics. Indeed, one of our patients (case 4) received no antibiotics prior to the onset of symptoms. It can occur in nonoperative conditions or as a postoperative complication. In the former, however, it is almost always associated with the previous administration of antibiotics whereas postoperatively it may occur with or without such therapy. Two of our patients had no surgical procedure to the gastrointestinal tract.

Etiology and pathogenesis. Often the staphylococcus aureus is found by direct culture of the feces, but other organisms apparently can produce the same picture. When the staphylococcus is present it may produce an enterotoxin¹⁸ which accentuates the picture. Stool cultures were prepared on 4 of our patients. Two revealed staph. aureus, one staph. albus, and the fourth one, proteus vulgaris and E. Coli. On both occasions (cases 3 and 7) in which staph. aureus was cultured, it was resistant to all antibiotics but erythromycin. The staph. albus was resistant to all antibiotics, including erythromycin. That staph. aureus (coagulase positive) often is resistant to one or all antibiotics, even erythromycin, seems increasingly evident from the literature at hand. This may be due, in part, to the indiscriminate use of antibiotics.

A study of our patients does not settle the question of the exact role of the antibiotics in the production of the disease nor of the staph. aureus as the guilty bacterium. We agree with Wooldridge and Swinton²⁰, however, that it is oversimplification to believe that this disease is caused by the suppression or alteration of the normal intestinal flora by antibiotics which permit the staphylococcus to assume pathologic proportions. In the first place, not all patients have received antibiotics, nor can the staphylococcus always be cultured. Although the apparent response of sensitive organisms to erythromycin is well documented in the literature as well as in our own patients, the exact effect of this antibiotic is not certain. Once the diagnosis has been made we have been unwilling to withhold this drug because the severity of the disease outweighed our scientific curiosity. One patient, however, (case 5) was treated before we recognized this entity and recovered without erythromycin. Another (case 7) recovered in spite of the fact that the nurse neglected to give him erythromycin.

Even though it is difficult to be certain of the etiologic relationship of the antibiotic to this disease, sufficient evidence has accumulated to warrant a word of caution in the indiscriminate use of these agents because of the danger of this unfortunate complication.

We also are impressed by the hormonal aspects of the acute enterocolitis. When adrenal cortical insufficiency appeared, we administered cortisone on 2 occasions (cases 3, 7). Both patients responded dramatically but in one instance erythromycin was given simultaneously.

Posterior pituitary dysfunction is suggested in patients 3 and 4, who exhibited severe dehydration in the face of very adequate urinary volumes of 2,000-3,000 ml. per day. We have not yet completed studies to prove or disprove this provocative thought but the suggestion is definite.

Treatment. Because the etiology and pathogenesis of the disease is not firmly established, suggestions for its prevention are difficult. A rational treatment, however, is possible and has proved successful in our experience.

The most important therapeutic step is the accurate replacement of fluid and electrolytes. In many mild to moderate cases this may be all that is required. In the severe case fluid exchange of 8-12 liters per day is possible. When one realizes this is twice the normal blood volume, the importance of adequate replacement becomes obvious. With such a tremendous fluid exchange the most accurate method of replacement is essential. This necessitates not only volumetric collection of urine and gastrointestinal secretions, but chemical analysis of each for the important ions. Water and electrolytes are replaced on a quantitative basis. This accurate approach to replacement therapy is doubly important because of abnormal renal function which makes it impossible to rely upon chemical analysis of the serum alone to estimate the amount of electrolyte and fluid replacement necessary.

The second therapeutic principle is to attack the organism, if possible. For this the antibiotics are discontinued, the stool cultured and sensitivity tests run on the organisms. The appropriate antibiotic then is administered. In some cases there may not be time to wait for the laboratory studies. An empiric trial of erythromycin in those patients after culture has been taken seems justified.

The third indication, we believe, is for hormone therapy, usually cortisone. In at least one of our patients (case 3) there was an adrenal cortical insufficiency, either absolute or relative, as proved by the eosinophil count. After the administration of cortisone improvement was dramatic as the eosinophil count decreased. An exact cause and effect relationship is not established because erythromycin was given at the same time. The indication for cortisone was definite in any case and we believe it should be used when there is evidence of adrenal cortical insufficiency.

All has not been told about this disease entity, particularly in regard to the etiology and pathogenesis. Careful and open-minded studies of the affected patients will help in the future. We believe careful attention to both the hormonal and bacterial aspects will prove fruitful but the most important therapeutic measure is the maintenance of fluid and electrolyte balance in the early phases of the syndrome. In any case we believe a plan of therapy which usually is successful is available at the present time.

SUMMARY AND CONCLUSIONS

Seven patients exhibiting acute enterocolitis (pseudomembranous enterocolitis) have been presented, 2 medical patients and 5 postoperative patients.

The role of antibiotics in the production of this disease is a definite one, but not the only factor in its cause.

Broad spectrum antibiotics should not be used indiscriminately.

There is a strong suggestion in this syndrome of hormonal imbalance involving both the adrenal cortex and the posterior pituitary. Further studies are necessary to clarify this.

A rational therapeutic program includes:

- a). Careful fluid and electrolyte replacement. (Probably the most important single item of therapy.)
- b). Discontinuation of antibiotics;—stool culture and determination of sensitivity of the organism to antibiotics followed by administration of the appropriate antibiotic.
- c). Administration of cortisone if there is adrenal cortical insufficiency as detected by eosinophil counts and/or Thorne test.

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SURGICAL MANAGEMENT OF PEPTIC ULCER: A STUDY OF ONE HUNDRED CONSECUTIVE CASES

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Continuous additions to the already vast literature on peptic ulcer attest to the fact that the ideal therapy for this disease has certainly not been found; nor is there unanimity regarding the surgical attack. Lewis¹¹ recently mentioned 17 different resection technics, of which only a few are generally acceptable. Among the latter are the resection offered by Nagel¹⁵ in which the major portion of the greater curvature, with its high concentration of acid secreting cells, is removed, leaving most of the lesser curvature; and the increasingly utilized 50 per cent resection plus vagotomy.

Smithwick¹⁹ stated, "We have been following patients who have had a hemigastrectomy and vagotomy performed in the treatment of duodenal ulcer during the past 6 years. As time goes on, the superiority of the 50 per cent and vagus group becomes increasingly apparent. There have been no recurrent ulcers."

This technic has a place in our surgical armamentarium but surely is not the final answer to the problem of peptic ulcer. It has a definite morbidity and occasionally serious late complications.

Marshall¹² stated, "I am of the opinion that, in view of the fact that so many patients who have a vagotomy have a recurrence of their acids, one will see an increasing number of jejunal ulcers after these hemiresections. . . . We have not been enthusiastic about the Billroth I procedure. These people have dumping syndrome, they also have recurrent ulcer."

Brooks and Moore² sum up a *reductio ad absurdum* in gastric surgery: "If," they say, "one accepts the time-honored physiologic concept of gastric secretion and acid-pepsin as factors in the etiology of peptic ulcer, one would of course sever the vagus nerve to control the cephalic phase; then the digestive or humoral phase would have to be controlled by antrectomy and removal of the pyloric ring; and if we are to control the intestinal phase and other gastric stimulants, we will also have to remove the body and the fundus of the stomach. Possibly, adrenalectomy must also be added." Any operation must stand or fall, therefore, not on physiologic theory but on its record of recurrence.

This paper is a report of 100 consecutive cases of peptic ulcer resected by the Hoffmeister high subtotal antecolic resection technic. There was one hospital death on the twenty-third postoperative day from pulmonary embolus, confirmed at autopsy. Thus we believe that we have proved, at least to ourselves, that this type of resection is safe. The series includes poor risks, such as 3 patients who were bleeding severely at the time of operation.

This operative resection removes 75-80 per cent of the stomach, including three-fifths of the greater curvature, all of the lesser curvature if possible, and

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whenever possible (in 95 per cent of the patients) the entire antrum. If all of the antrum cannot be resected safely, we cone it out and perform a vagotomy. We cannot convince ourselves, either from the literature or our own experience, that vagotomy is a necessary adjunct to an adequate high subtotal resection. If for some reason a vagotomy cannot be performed, the patient probably will need an antrectomy later. At this second stage, a vagotomy is in order, if practicable.

The duodenal closure has our marked respect. We always drain the doubtful closure and in 3 instances have inserted a catheter into the duodenal stump as suggested by Welch.²² The technic is simple and in each of these patients the convalescence was uneventful. We do not crush the duodenum with a clamp or section it with cautery. We suture it by the "open closure" method for the following reasons: (a) we can inspect the interior for ulcer and/or stricture, (b) we can free up the stump more easily with a finger inside the duodenum if this is found necessary, (c) we can save every last millimeter of tissue for the turn-in, (d) we can ligate under direct vision the occasional bleeder in the cut edge of the duodenum. We do not like to imbed the stump into the pancreas but would rather suture omentum over it. We do not disturb an ulcer deeply eroding into the pancreas for fear of pancreatic leakage. Although the duct of Wirsung is the major efferent in 90 per cent of the patients, in the remaining 10 per cent the duct of Santorini is the essential duct. This duct has been seen at autopsy in the ulcer. Therefore we would rather section the duodenum proximal to the ulcer or even transect the pylorus, cone it, and then perform a vagotomy.

In our series of 100 consecutive resections the following operative complications occurred: 1. Five instances of wound dehiscence. Four of these had been sutured primarily with cotton in layers. The addition of retention sutures had not prevented this complication. The fifth patient had a midline incision primarily sutured with wire traversing all layers but the skin. We therefore, thereafter, employed a longitudinal muscle splitting paramedian incision plus wire sutures, and have seen no evisceration for the past 3 years. 2. Two wound infections, one slight, and one severe. It is of interest to note that the severely infected wound was sutured with wire. It did not dehiscence and healed satisfactorily. 3. Six instances of mild postoperative gastrointestinal bleeding. A seventh patient was reoperated upon because of brisk hemorrhage coming from the suture line high on the lesser curvature. Since this incident 2 years ago we have used interrupted mattress sutures along the lesser curvature as the first suture line and have had no recurrence of this complication.

Ninety-four of our 100 resections were followed from 6 months to 5 years. Over 60 per cent were followed from 6 months to 2½ years and the remainder from 2½ to 5 years.

Late end results: 1. We have not found the *dumping syndrome* to be a prominent factor. In 8 patients it persisted to a mild degree for 6 months, in 1 patient it was present after 9 months. Avoidance of sweets and liquids at meals gives relief in almost every case. Occasionally Pancreatin or Entozyme 10 gr. three times a day causes this syndrome to disappear. 2. *Weight loss* or persistent underweight is a troublesome factor. Twelve patients have lost from 10 to 25

pounds since leaving the hospital and have not regained their weight. One patient lost 40 pounds. The underweight factor does not seem to concern the majority of patients; most are asymptomatic and working regularly. MorCal* is an aid in producing weight gain.

Postgastrectomy weight losses apparently are related to decreased caloric intake despite frequent meals. Such losses are not clearly related to small bowel transit time, nor to abnormal pancreatic function as determined by laboratory tests. Excessive nitrogen loss is infrequent. The factor of greatest importance seems to be loss of the large gastric reservoir. Current interest in the 50 per cent gastric resection, with its larger reservoir is obviously an attempt to answer this problem.

A large number of our patients admit to a persistently diminished capacity for food, and unless urged to eat more, they will take small meals for many months. Quite a number employ a bland diet even after a year or more. They are afraid, they say, of a full diet. These individuals are able to work, however, and do not seem to object to a limited diet. Part of the difficulty is psychic. We have noted that if the surgeon does not volunteer information as to how much stomach has been removed, or if he will minimize this factor and urge the patient to continue eating beyond the "full" sensation, unless this sensation becomes severe, that slowly this symptom will diminish and usually disappear. It is our conviction that these patients must be carefully followed and counselled-in many cases as long as 2 or 3 years.

About 10 per cent of our patients, persistently had very mild postoperative epigastric distress, unrelieved by medication. Two patients called it pain. Three patients had epigastric discomfort and evidence of marginal ulcer by roentgenogram 2 or more years postoperative; 2 of these healed spontaneously and have remained asymptomatic. A third patient submitted to vagotomy and has remained asymptomatic.

Five patients had late gastrointestinal bleeding. Three of these were poor operative risks and were not subjected to antrectomy, coning or vagotomy. One patient who subsequently had a vagotomy has had no recurrence of bleeding. However, he now has discomfort from a hiatus hernia noted 3 years postoperative. A second patient was subjected to an antrectomy and vagotomy, but after a year bled again. At reoperation the abdominal cavity was entered via a transthoracic transphrenic approach. The vagi were sectioned above the diaphragm. A marginal ulcer that involved the mesocolon was discovered. In the 3 other patients bleeding ceased spontaneously and has not recurred.

* MorCal: Schenley Laboratories

	Percentage
Refined Vegetable Fat.....	44.0
Carbohydrate.....	42.0
Protein.....	9.0
Mineral Ash.....	2.5
Moisture.....	2.5
Vitamin B1 (Thiamine mononitrate, 50 mg. per lb.)	
Vitamin B2 (Cyanocobalamine, 50 meg. per lb.)	

In a study of 172 marginal ulcers, the Lahey Clinic¹³ noted that 22.7 per cent appeared after a subtotal gastrectomy. Most of these patients apparently had inadequate primary resection elsewhere. Of the gastrojejunal ulcers 2.9 per cent had appeared after resection for gastric ulcer. That clinic states, and we agree, that the importance of the short jejunal loop as it relates to marginal ulcer has been over-emphasized. An antecolic anastomosis can be made with a very short loop. If the omentum is thick it may be incised or partially removed.

The interval between resection and the development of gastrojejunal ulcer may be from a few weeks to as long as 30 years. Approximately one-third will occur during the first year, another one-third the second year, and the remaining one-third thereafter.

Seventy per cent of the 94 patients followed in our clinic are able to work. Among those not working, disability often is due to many factors other than gastric. Two patients have cardiac disability and become dyspneic on effort. One patient has developed thyrotoxicosis, another has an advanced carcinoma of the prostate; a third an abdominal aneurysm, a fourth has had 2 strokes; and 3 have severe arthritis, etc.

We follow the usual indications for gastric resection. We present them in what we consider to be the order of their importance.

1. We are among those who believe that *all gastric* ulcers should be treated by resection. The sharp decrease during the past decade in mortality of gastrectomy, whether subtotal, radical subtotal, or total has swelled the advocates of those advising operative interference.

There were 20 gastric ulcers in this series of 100 resections with a zero operative mortality. During the same period 2 patients with gastric cancer underwent a radical subtotal resection without operative mortality. It is recognized that operative mortality for gastric ulcer resection is low. It is common knowledge that the 5 year salvage rate for gastric cancer is deplorably low. Despite two or three encouraging reports, it is apparently less than 10 per cent throughout the country.

Figures regarding 5 year salvage for gastric carcinoma are misleading unless it is based on a consecutive series of patients, treated or untreated, during a given period. Thus, of 100 such cases reviewed by Ochsner,¹⁶ 86 patients were considered operable; of the 86 only 37 were resectable; of the 37, only 12 were considered curable.

Even though the ulcer disappears by follow-up roentgenograms, and although the ratio of gastric cancer to benign ulcer is, according to Schindler¹⁸ 1 to 200 the stomach, in our opinion, should still be resected once the diagnosis of gastric ulcer has been made.

In a series reported by LaDue¹⁰ early cancer was identified in 0.2 to 0.5 per cent of asymptomatic patients x-rayed. It is sound practice to order an upper gastrointestinal series even though mass roentgenograms have been relatively unrewarding.

It is common knowledge that cancer has been found at operation even though an ulcer has been declared healed by roentgenogram. Even with a good roentgenologist there is an approximate error of at least 5 per cent. LaDue¹⁰ stated

that his roentgenologist reported normal findings in 5.5 per cent of patients in whom cancer was found at operation; and the good gastroscopist will have an error of as high as 16 per cent.

If the surgeon cannot be sure of the diagnosis even as he views and palpates the tumor in the open abdomen; if negative biopsy is worthless; if the Papanicolaou test is uncertain; if occasionally the pathologist misses cancer even after a study of serial sections, what then can the clinician advise but resection of every gastric ulcer? An individual over 40, who has been previously well and who suffers from persistent indigestion is certainly under suspicion, and should be considered for laparotomy despite negative laboratory and roentgenologic findings.

For the large gastric ulcer, a radical subtotal is indicated including splenectomy, and perhaps a partial pancreatectomy with the nodes behind it, wiping down the nodes about the left gastric artery and at the portahepatis and excising a goodly section of the duodenum. Coller⁶ found the duodenum involved in 26.4 per cent of gastric resections for cancer.

Caruolo⁴ has a recent encouraging word for the large posterior wall ulcer. At the Mayo Clinic he studied 91 such cases over a six year period, the ulcers varying in size from 1.5 cm. to 4.5 cm., and with 80 per cent adherent to the pancreas. A radical subtotal was done in each patient. Three of the 91 were cancer, but in not one of the 3 was the diagnosis correct clinically or by roentgenogram.

During this same six year period at the Mayo Clinic over 1,000 gastric ulcers were seen, making the incidence of *posterior wall ulcer* that was cancerous 0.3 per cent. Thus, if one meets a large posterior wall ulcer, one should make every effort to remove it and be quite radical locally. In the instances in which benign ulcer was removed from the pancreas by sharp dissection there was no pancreatitis.

The second item of our credo is: Resection after the *first* massive hemorrhage from peptic ulcer.

McKay¹⁴ studied vascular changes in the ulcer bed and immediate surrounding area of 35 patients who had had massive hemorrhage and who came to autopsy. He also studied the gastric and duodenal vessels remote from the ulcer area. The changes seen depended, apparently on the extent and duration of inflammatory reaction, regardless of vascular pathology elsewhere. The pathologic changes included invasion of vessels by inflammatory cells, irregular proliferation of the intima, replacement of smooth muscle of the media by fibrous tissue and inconstant dehiscence of elastic fibres. Thus it may be conjectured that severe bleeding is the result of lack of contractility because of fibrous tissue encroachment and poor coaptation of the intima due to irregular intimal proliferation, and not arteriosclerosis. Osborn¹⁷ in a review of 327 partially removed stomachs found no instance of arteriosclerosis of the gastric vessels in the neighborhood of the ulcer. He described the "acute, subacute and chronic ulcer" and stated that in his opinion the "acute erosion" is the typical lesion of the fatal hemorrhage. Thus, the *age of the ulcer* plus inflammatory changes determines the tendency to massive bleeding—not necessarily the age of the patient. It is recognized that the older

patient who bleeds is, of course, the greater risk and thus resection after (or if necessary during) the first hemorrhage is even more imperative in such an individual than the younger patient; for with the second hemorrhage the older individual is a still greater risk.

Harvey⁹ gives as the reason for the admission of gastrointestinal bleeding patients to medical wards that, "medical residents must be trained in the management of these cases." He goes on to say, "With us it is difficult to assess surgical vs. medical management because the patients that come to surgery are almost invariably the worst cases."

We believe that we have solved this problem in our hospital: Through the courtesy of the Chief of Medicine, all patients who have major gastrointestinal bleeding are admitted to the surgical wards. However all such patients, continue to be a joint medical and surgical problem. We believe that if we are going to see these patients frequently and perhaps be responsible for their surgery we can be more effective if we watch them on our wards.

The indications for operation in these bleeding patients of ours are: (a) bleeding recurring after 24-48 hours, (b) inability to maintain blood volume, (c) a continuous slow leak of blood via the gastrointestinal tract, (d) the massive bleeder who is also a poor risk and who may become a worse risk. If the patient is not bleeding at the time of operation, the mortality is low. After the first hemorrhage, there is always the threat that with the second, one may have to operate *during* rather than *after* the hemorrhage.

Ominous factors with massive hemorrhage are: (1) constant pain prior to the hemorrhage, (2) previous massive hemorrhage, (3) previous perforation.

A Bromsulphalein retention test should be routine if there is time. It is rarely normal if esophageal varices are present.

Using age per se (i.e., above or below 50) as a criterion for surgery in these patients is not always valid. McKay¹⁴ stated that to decide that the bleeding ulcer in the patient under 50 will probably be a self-limited and nonfatal disease is to invite disaster. Fortunately such optimism is not widespread.

Caswell,⁵ in a series of 84 patients with massive hemorrhage, reported that 16 were under 40 years of age.

How should one manage the patient with negative upper gastrointestinal findings but with massive gastrointestinal bleeding? A logical basis for removing an apparently normal stomach in such patients is the fact that frequently shallow ulcerations are present in the gastric mucosa which cannot be seen or felt at operation. Eusterman⁸, of the Mayo Clinic, estimated that 85 per cent of upper gastrointestinal bleeding is due to peptic ulcer.

Obviously, if there is time, one must exhaustively search for a cause for the bleeding; there must be a gastrointestinal roentgenogram as early as practicable and a liver profile must be completed. If there is melena without hematemesis or blood in the stomach, a barium enema is in order. The patient must be x-rayed for hiatus hernia and esophageal varices, and if possible an endoscopy should be included. However, if all studies fail to reveal the source and the patient continues to bleed, the abdomen should be explored and if negative for other pathol-

ogy, a subtotal resection should be done. If we decide from laboratory, clinical and/or roentgenologic findings that we are dealing probably with cirrhosis, it is our custom to perform a transthoracic esophagotomy and suture varices if found. If there are none, one can still enter the abdomen via the diaphragm and do a subtotal gastric resection from above. Occasionally, with an obese and/or a long-chested patient such an approach actually is easier than one performed below the diaphragm.

Our third credo: We advise subtotal resection whenever possible after perforation of a peptic ulcer, although it is our custom to do this as a two stage procedure. Immediate resection can be performed, and it is being performed frequently with remarkably low mortality. Bisgard¹ stated, and we agree, that all of the following conditions indicate resection, either primary or secondary: (1) gastric perforation with its threat of carcinoma, (2) peptic perforation plus hemorrhage, (3) or plus obstruction, (4) or perforated stomal or jejunal ulcer, (5) recurrent perforation in any of the above areas.

The perforating ulcer has a diathesis of a particularly refractory type; and simple closure does not, of course, alter the course of this disease. Contrary to general opinion, over 80 per cent of individuals with perforations have had ulcer symptoms, although perhaps slight and of short duration. As one would expect, the longer the duration of these symptoms, the more intractable is the ulcer and the more likely it is to develop complications.

Primary resection for perforation is not new. Thirty-three years ago Brütt² endorsed the suggestion of Von Haberer that a surgeon confronted with a perforation of a peptic ulcer do an immediate resection and that the condition rather than the complication was the important consideration.

Almost 20 years ago, Yudin²³ reported 418 cases of perforated peptic ulcer of which 331 patients were good risks and were resected with a mortality of 7.8 per cent. Eighty-seven were considered poor risks and were treated with simple closure with a mortality of 32 per cent.

Clinical experience has shown that the peritonitis associated with perforation of a peptic ulcer does not appear in the first several hours and usually is well tolerated.

One reason that immediate resection is not popular is that the perforation must often be cared for by the less skilled and less trained surgeon, perhaps at night when assistance is harder to obtain. Surely a surgeon under these conditions cannot be blamed if he pockets his pride and does a simple primary closure.

The merits of any clinical procedure are of course determined by clinical results. Two requirements must be met: The patient must acquire a better end result regarding freedom from symptoms and permanent cure, and there must not be an increased risk to life. For instance, Emmett and Owen⁷ reported 46 cases with a 0 per cent mortality; and Harvey⁹, 24 cases with a 0 per cent mortality rate, totalling 70 instances of primary subtotal gastric resection with a zero mortality. Several series which do not exceed, and in fact are less than the present over-all mortality figure for simple closure are now appearing in the literature. It must be emphasized again, however, that the surgical team must be

trained and there must be common sense in the selection and preoperative preparation of the patient.

Technical advantages of primary resection: The edema accompanying the perforation sometimes delineates tissue planes and facilitates dissection.

The disadvantages of simple closure: Turner²¹ (147 cases) reported late results after such closure: 84 per cent ulcer symptoms recurred

75 per cent severe

38.5 per cent were subjected to additional surgery

Symptom recurrence rate tends to be about 40 per cent the first year, but over 70 per cent during the next 4 years. Whereas 90 per cent of the resected patients are symptom free after 5 years or more.

As an aid in deciding between resection or simple closure, Troell²⁰ observed that patients with no definite antecedent symptoms had a recurrence rate of 42 per cent after simple closure. A group of patients whose preoperative symptoms existed 6 months or more had a recurrence rate of 78 per cent.

It is our belief that if the patient is in excellent condition; if resection is not technically too difficult; if an experienced surgical team is available, and if a two stage procedure imposes a hardship, immediate resection may be considered and probably is indicated. Obviously, wisdom is necessary in the selection of these cases.

After perforation we urge resection, either primary or secondary, because as shown above, although only about 35 per cent of these patients may be forced into resection by severe complications, there is approximately another 40 to 45 per cent who have enough morbidity, such as intermittent bleeding, intermittent obstruction, persistent epigastric discomfort, etc. to warrant it. We are on firm ground in advising secondary resection. The mortality is extremely low.

There were 19 secondary resections following perforation in our series. Of this group of 19, 2 had also had massive hemorrhage, 2 had had severe loss of weight (25 to 50 pounds) 4 had had obstruction (2 mild, 2 marked), 2 had persistent vomiting without obstruction, 2 had had persistent abdominal pain, 1 had a persistent ulcer as noted by roentgenogram and 2 had reperforations. There was no mortality following secondary resection.

During the same period we also performed simple closure on 6 perforated ulcers. There was 1 death in this group, an 82 year old Negro whose gastric ulcer perforated while he was convalescing from a thigh amputation. He died from a pulmonary embolus, diagnosed by roentgenogram and clinical observation. The other 5 patients convalesced without event although advised to have subtotal resection, have so far eluded us. A seventh patient with a history of epigastric pain was admitted in surgical shock. Roentgenologic examination showed pneumoperitoneum. Despite such supportive measures as transfusions, gastric suction and oxygen, he died.

We have treated 1 patient with a perforated ulcer conservatively. Roentgenologic examination showed pneumoperitoneum. He refused surgery and therefore was placed on constant gastric suction, parenteral fluids and antibiotics and recovered, only to scorn a subtotal resection. He also continues to elude us.

We do not favor a planned conservative treatment of perforated ulcer, although occasionally this type of management is necessary. An interesting variation of the above occurred recently. An emphysematous patient entered the hospital in poor condition. Although demonstrating pneumoperitoneum by roentgenogram, he did not seem to fit the picture of perforation. He was put on suction. He continued atypical—closer questioning revealed the source of the pneumoperitoneum. It had been induced by his doctor treating his emphysema.

We therefore restate a simplified thesis regarding peptic ulcer perforation: If 100 such patients enter the hospital; between 1 and 6 of them will die following simple closure, and between 0 and 3 will die if immediately resected. If simple closure is performed, about 40 will have to be resected later. After simple closure, 40 will have mild to severe symptoms in the first 12 months, and about 75 will have symptoms during the following 4 years. There may be one or more deaths from ulcer complications after simple closure. It is our belief, therefore, that the closure of a perforation may, and probably should, be considered as the first of a two stage procedure, the second following the first after an interval of 3 to 6 weeks.

After resection, on the contrary, 10 will have recurrent symptoms during the first 5 post-operative years. These 10 may need vagotomy, subtotal re-resection or both.

We do not anticipate any argument as to the therapy of the fourth group—the peptic ulcers that obstruct and which do not respond to medical care, for resection with this group of patients tends to give excellent results. If they are undernourished or if we believe that thereby we can speed up preoperative preparation, we do not hesitate to institute a preliminary jejunostomy. We have not found this procedure necessary after operation save in 2 instances. In an occasional debilitated and older patient who is obstructed and who cannot tolerate even a limited gastric resection, a simple gastroenterostomy with a vagotomy, if practicable, is acceptable. However, in some instances we have found that it is about as easy to do an adequate subtotal resection as a vagotomy.

Finally there is the patient with the peptic ulcer who has persistent symptoms despite adequate medical care. This is the most disappointing group of all and the one that in our hands has the highest postoperative morbidity. They probably are best treated with a 50 per cent resection and vagotomy. At laparotomy, one should search for hiatus hernia even though it is not demonstrable by roentgenogram.

It is possible that the reason certain reported series of radical gastric resections do not do well from the morbidity viewpoint is that the indications for operation have not been concise enough. Or the operation may not have been sufficiently radical. If an ulcer is allowed to perforate more than once, or have a massive hemorrhage more than once, or obstruct 2 or 3 times, or repeatedly heal and recur, is not the patient heading toward increasing morbidity? Does not his ulcer tend to become ever more rigid? Is he not a worse surgical risk than if he had been subjected to surgery after the first hemorrhage or the first perforation or the first stubborn obstruction? When operating we should employ, we believe, either a high subtotal or a 50 per cent resection plus vagotomy.

We do not yet favor the "reverse resection" (i.e., leaving the lesser curvature with or without the antrum and excising the greater part of the fundus). This operation, we think, has perhaps not yet withstood the test of time.

In considering a 50 per cent subtotal resection plus vagotomy, there are these points to remember: 1. Despite one's best efforts, the vagi are not always adequately excised. A few fibers are so small as to be missed by the finger or the eye. 2. Recent literature indicates that despite a clinically adequate vagotomy combined with a 50 per cent subtotal resection recurrent symptoms may occur 2½ to 3 years postoperatively.

CONCLUSION

One hundred Hofmeister antecolic type high resections for peptic ulcer are presented with a 1 per cent mortality. It is perhaps the most efficient therapy for the complications of peptic ulcer.

All gastric ulcers should be treated by early subtotal gastric resection, unless other conditions contraindicate.

All peptic ulcers that bleed massively should have a subtotal gastrectomy after the first hemorrhage.

All ulcers that perforate should be treated, either by a primary or secondary resection.

A 50 per cent subtotal resection plus vagotomy is indicated for: (a) the patient with persistent ulcer symptoms despite adequate treatment; (b) the patient with ulcer complications who is persistently and grossly underweight; (c) the highly nervous, anxious patient.

It is necessary to carefully follow for a year or more the management of most patients who have had gastric resections. Some must be followed for 2 to 3 years.

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A NEW TYPE T TUBE

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After incising and exploring the common bile duct, most surgeons prefer to establish external drainage by means of a T tube or catheter. The vertical limbs of most of the T tubes in common use have a small mouth, making it difficult to attach them to syringes for irrigation at the time of the operation, or later to attach them to some type of drainage apparatus for collection of bile. Some surgeons advise against attaching the tube to the abdominal wall, but most others make some effort to secure the T tube either to the skin of the abdominal wall, or to the abdominal wall dressing. It has been our practice to use a latex tube, generally of small caliber, to irrigate it at the time of surgery, to secure it to the



FIG. 1

skin of the abdominal wall, and later attach it by means of an adapter to a second tube and a bottle at the bedside. It has been our experience that it is difficult to adequately secure the ordinary vertical limb of the tube to the skin of the abdominal wall. We have devised a tube with small tabs on the vertical limb which can be attached easily to the skin of the abdominal wall by means of a fine silk suture. The distal end of this vertical component has been funnelled, such as in an ordinary urethral catheter, in order that the tube can be readily irrigated or fitted to an adapter for external drainage.

Figure 1 is a photograph illustrating this type of tube which is no. 12 French in size, fashioned from latex rubber. It should be emphasized that the silk suture attaching the tab to the skin of the abdominal wall should be lax enough to allow some leeway for abdominal distention, vomiting, etc., in order to keep from disrupting the transverse limb from the common bile duct. If the individual

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surgeon prefers not to attach the T tube to the abdominal wall skin, the tabs can be disregarded, and, in like manner, if he does not prefer to attach the tube to an adapter, he can simply disregard the funnelled end, or for that matter, cut it off without in any way impairing the usefulness of this type of external drainage apparatus. It would seem that T tubes would occasionally and inadvertently be withdrawn from the common duct at the time some attendant was struggling to connect a tube with a very small lumen to a glass adapter. This accident has happened on our service on at least 2 occasions. These accidents prompted us to request the Davol Rubber Company to develop the type of tube noted in the illustration.

SUMMARY

A simple new type of T tube for external drainage of the common bile duct is described. A design permitting ease of attachment of the tube to the abdominal wall skin, as well as the fitting of an adapter for external drainage, has been accomplished.

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EDITORIAL

BILATERAL INGUINAL HERNIAS: SHOULD BOTH SIDES BE OPERATED UPON AT ONCE?

This question is frequently asked. What is the answer?

Certainly the practice among surgeons is very variable. A great many surgeons operate upon both sides at once in order to save the patient time. We know one surgeon, who when operating for a unilateral hernia, invariably operates upon the other side also, even though no hernia is demonstrable on that side. He does this as a prophylactic measure to prevent the occurrence of a hernia on that side. This we believe, is going too far. It is true that a patient who has a hernia on one side is more likely to develop another hernia than someone who has no predisposition to this condition. But, on the other hand, many people with unilateral hernias never develop hernias on the other side.

Other surgeons never operate upon the two sides at one sitting. This practice is especially prevalent in the Armed Forces where time is not of the essence of the situation and is not considered to be so important for the service man. This, of course, is a mistaken point of view, because every man-hour lost by one service man has to be made up by another, and the poor taxpayer pays the bill. It goes without saying that the time element is highly important with people in civil life. Exclusive of the time element, though, a great many patients refuse to have two separate operative procedures, even if they are placed only a week apart during one hospital stay, which would prolong the convalescence only immaterially.

It is our feeling that a happy medium between the extreme views presented above is justified. If the two sides can be operated upon without tension, we do not believe that the double procedure greatly increases the chance of recurrence.

There are two reasons usually given for not operating upon the two sides at the same time. The first is that the recurrence rate is higher if the two sides are done at once. There have been a good many statistics published to prove this. The second is that the chance of infection is greater if both sides are operated upon at the same time. There are figures to show that when infection occurs in bilateral hernia repair, it generally occurs on the second side operated upon.

Undoubtedly these reasons have some cogency. As to the first reason, it is not believed that the recurrence rate should be any higher in cases *properly selected* for bilateral repair. As to the second reason, every surgeon has an occasional infection in clean wounds. The offending organism most frequently encountered is *Staphylococcus aureus*. The source of these infections is probably in the nasopharynx of the personnel of the operating team. The organism is known to be a constant inhabitant of everyone's nose and throat. Constant effort is being made to eliminate these troublesome infections.

We believe that the bilateral operation can be safely and uniformly successfully done if the patient has reasonably good structures, and if adequate relaxation incisions are made in the sheath of the rectus muscle on each side. The im-

portant thing is to do the operation without tension, and not have one side pulling against the other. It is our practice in bilateral cases to operate upon the worse side first. If we find a situation (large defect and poor tissues) which we think would make it inadvisable to operate upon the second side at the same sitting, we do not do it, even though the patient may have been told beforehand that both sides would be operated upon. Poor tissues and tension are the main factors involved. When the patient comes out of his anesthetic, and finds that only one side has been operated upon, we carefully explain the reason for it. The reaction is variable. Some readily consent to have the second side done a week or 10 days later. Some refuse ever to have the second side operated upon. The possibility of this refusal should not influence the surgeon. The decision should be made solely on the basis of a permanent cure of the patient's hernia. It is much better to be sure of a permanent cure on one side, than to do both sides at once, and to run the risk of getting a cure on only one side, or maybe on neither side.

By following this practice, we believe that as good results can be obtained in patients with bilateral hernias as in those with only single hernias, despite the fact that most recorded statistics are to the contrary. The poorer results in the operation for bilateral hernias are probably due to poor judgment in *routinely* doing both sides at once, in spite of the conditions found at the time of operation.

Certainly the only criterion in making the decision is the consideration of what is best for the patient. It is our belief that in most cases, it is in the interest of the patient to operate upon both sides at one sitting, although there are occasional cases in which this is not true. The use of tantalum gauze as a scaffolding for the ingrowth of supporting fibrous tissue has made it possible for us to operate upon more cases of bilateral inguinal hernia at one sitting than we formerly thought it desirable to do.

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BOOK REVIEWS

The editors of The American Surgeon will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.

Clinical Urology. Edited by OSWALD SWINNEY LOWSLEY, M.D. AND THOMAS JOSEPH KIRWIN, M.D. Illustrated by William P. Didusch. Williams and Wilkins Co., Baltimore, Md., 1956. Third Edition. Two Volumes \$32.50.

The two volumes total 985 pages and bring the previous editions up to date. It is superbly illustrated with additional drawings.

The field of urology is covered in a concise and well organized manner and is authoritatively documented by an extensive bibliography.

Although the content is too extensive for use as a student text book it should prove to be a highly useful reference for them. Interns, residents and practicing urologists will find it to be a valuable reference work.

CHARLES EBERHART, M.D.

Campbell's Operative Orthopedics, Volumes I and II. Editor: J. S. SPEED, M.D., Associate Editor: ROBERT A. KNIGHT, M.D. Third Edition. Clothbound. C. V. Mosby Company, St. Louis 3, Missouri. 1956. Price \$40.00.

The previous editions have been accepted as a masterly compilation of current orthopedic thought. It remains for the third edition to bring this to date. This has been done thoroughly and completely. The first few chapters reflect the fundamentals upon which good surgical practice is founded. These can be read with profit by resident or practicing surgeon. The remainder of the book is divided into complete chapters covering the entire operative phase of orthopedic surgery. Yet there is sufficient background material presented that slyly seduces one into the excellent bibliography at the end of each chapter.

The literature has been well combed and this current material incorporated. Sufficient and adequate alternatives are given so that the individual is not led into blind acceptance but thoughtful consideration. The diagrams and illustrations are excellent. The paper and print are easily read and serve only to compliment the publishers, who too, must recognize this as a classic in surgical literature.

The third edition of this monumental work deserves an easily accessible place on the shelf of everyone practicing orthopedic surgery as it will be used daily. This alone justifies the price.

RICHARD E. KING, M.D.



